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Efficiency of high-flow nasal cannula (HFNC) compared to conventional oxygen therapy (COT) on preventing reintubation in critically ill patients: A randomized controlled clinical trial

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Abstract
Background: Postoperative respiratory complications rank as the second most common complications after surgery and impose a significant strain on healthcare systems. This research aimed to evaluate the efficacy of preventive immediate application of high-flow nasal cannula (HFNC) in comparison to conventional oxygen therapy (COT) after extubating, with the goal of minimizing the reintubation rate.
Methods: A prospective randomized controlled clinical study was carried out on a cohort of 146 adult patients who had undergone extubation. The participants were allocated into two equal groups using a randomization process: Group A (control group) is the designated group that serves as a standard for comparison in an experiment. There were 73 people diagnosed with COT. Administered by nasal cannula or face mask. Group B is using HFNC therapy. There were 73 patients that were treated with HFNC.
Results: Comparing the Rox between the two studied groups after 6, 12 hrs. Showed a statistically significant increase in group B than group A, while there was not statistically significance difference after 24, 36 hrs. There was a statistically significance difference between the two groups when we compared the P/F ratio at 1, 4, 12, 24, and 36 hours. The HLS range for Group A (COT) was (3.0 - 12.0) compared to Group B (HFNC) (3.0 - 10.0) (P<0.001). This difference was statistically significance.
Conclusions: Post-surgical patient at high risk of ALI, the use of immediate HFNC compared to COT reduce the reintubation rate.

Keywords: HFNC, COT, reintubation, critically ill patients

Introduction

Postoperative respiratory complications rank as the second most common complications after surgery and pose a significant strain on healthcare systems [1].

Following scheduled extubation, patients are often given standard oxygen therapy as the primary supportive treatment. This therapy is traditionally supplied using nasal prongs, cannula, or masks. Nevertheless, these devices have a restricted capacity to supply peak oxygen flow rates. The maximum oxygen flow rate provided by COT is a mere 15 L/min, well below the requirements of post-extubation patients experiencing acute respiratory failure [2].

Consequently, the oxygen provided is diluted by the surrounding air, resulting in a considerable decrease in the percentage of inspired oxygen (FiO_2) in the alveoli. In addition, the delivery of oxygen by COT has challenges in meeting the heating and humidification needs of these patients [3].

High-flow oxygen treatment using a HFNC is a viable option for treating critically sick patients with hypoxemic respiratory failure, serving as an alternative to regular oxygen therapy and non-invasive ventilation (NIV).

Our hypothesis is that HFNC is more effective than COT in lowering the rate of reintubation. This hypothesis is based on the goal of minimizing lung de-recruitment and preventing hypoxemia following elective extubation, which in turn helps to decrease postoperative morbidity.

Prior research has shown many physiological advantages of HFNC, including a positive

airway pressure that is dependent on the flow rate and an augmentation of the amount of air remaining in the lungs after exhalation, indicating a potential impact of recruiting alveoli [3].

The objective of this research was to evaluate the efficacy of preventive rapid application of HFNC compared to conventional oxygen treatment (COT) after extubation, to reduce the incidence of reintubation.

The primary outcome was the occurrence of reintubation within 72 hours after extubation. The secondary outcomes were time of reintubation, complications, tolerance and comfort, duration of HFNC received, reintubation rates until ICU discharge, the duration of hospital stay and ICU mortality.

Patients and Methods

This research was conducted in two surgical critical care units, namely Tanta University Hospital and Tanta Cancer Center, using a prospective randomized controlled design. The study was conducted for a period of one year, namely from May 2021 to April 2022, after approval from the ethical committee of the Faculty of Medicine at Tanta University, under authorization number 34634/4/21. A well-informed written permission was acquired.

Inclusion criteria were post-extubation adult who were at high risk of postoperative ARDS as indicated by lung injury prediction score >7 [4], were randomly allocated to one of oxygen therapy groups.

The exclusion criteria included absence of informed consent prior to randomization, body mass index exceeding 40 kg/m^2, patients with tracheostomy, individuals with obstructive sleep apnea syndrome, those with underlying chronic neuromuscular disease such as myopathy or myasthenia gravis, patients with traumatic brain injury resulting in intubation, pregnant individuals, and patients with do-not-resuscitate orders.

Randomization

The patients were allocated randomly into two equal groups using sealed envelopes and a random number generator technique.

Group A (control group) 73 patients

COT is defined as a flow rate <15L/min. Applied through nasal cannula or face mask.

Group B (HFNC) 73 Patients

High-flow nasal cannula (HFNC) is defined as air/oxygen mixture at a flow ≥30L/min delivered via heated, humidified circuit and prongs.

Clinical management

The patients who successfully completed the spontaneous breathing experiment were promptly transferred to the surgical critical care unit after the surgical procedure.

HFNC (Drager Evita 300)

Patients who were unable to maintain an arterial oxygen saturation (SpO_2) level higher than 92% and a respiratory rate (RR) of 25 breaths per minute or more were started on a minimum flow of 30 L/min with a fraction of inspired oxygen (FIO_2) of 1. Subsequently, the FIO_2 was adjusted to achieve a SpO2 level over 92%, while the flow rate was modified based on the maximum tolerable level.

All patients were subjected to the following

Full history taking age, gender, body math Index (BMI), primary diagnosis, comorbidity, time to reintubation, reasons for reintubation, APACHE II, ROX index (The ROX index > 4.88 indicate the success of HFNC treatment at 6, 12, 24 and 36hrs) [5].

The occurrence of postoperative hypoxemia, pneumonia, reintubation, and/or the need for curative NIV due to postoperative respiratory failure. Duration of stay in intensive care units (ICUs) in hospitals.

Continuous monitoring of the vital signs was conducted at the patient's bedside.

Laboratory tests (Arterial blood gases were measured in all patients one hour after extubation, at 4, 8, 12, 24, 36 hrs) were recorded.

Sample size calculation

Based on previous study percent of exposed with outcome (HFNC) 4.9%, and percent of unexposed with outcome (Oxygen mask or low flow nasal canula) 21.2%. Revealed that sample size 132 at least (66 per group with increasing 10% loss of follow up so each group was about 73 patients) with Total 146 patients at 0.05 alpha error,80% power of study and ratio of exposed to unexposed 1:1 [6].

Statistical analysis

Microsoft Windows statistical software SPSS, version 25 (IBM Corp., Armonk, N.Y., USA), was used to evaluate the structured data that had been entered into an Excel spreadsheet. To examine the dispersion of the numerical data, the Shapiro-Wilk test was executed. Statistics that did not follow a normal distribution were shown using measures such as the median, range, standard deviation, and interquartile range (25^{th}-75^{th} percentiles). The normal distribution was used to show the data via the use of the mean, standard deviation, and range. We used percentages and numerical figures to display the qualitative data. In order to calculate, classify, and statistically analyse the data, the following tests were used: Mann-Whitney-The U-test may when compare two separate groups using nonparametric quantitative variables, the U Test (U) is used. For comparisons between two separate groups on parametric quantitative variables, the independent t-test (t) is used.

Whether you want to know whether two categorical variables are statistically related, you may use the Pearson Chi Square Test (χ^2). The Fischer Exact and Monte Carlo Exact tests may be used in its place when this one isn't suitable. The statistical metric known as the p-value indicates the level of significance. Not significant, if the p-value is more than 0.05; significant if the p-value is less than or equal to 0.05; and significant if the p-value is less than 0.001.

Results

A total of 209 patients underwent evaluation to determine their eligibility. A total of 57 patients were excluded from the research due to not meeting the inclusion criteria, while 6 individuals had their participation declined by their guardians. A total of 146 patients were randomly assigned to two groups. There were 73 patients in each group, with one group receiving continuous oxygen therapy (A) and the other group receiving HFNC therapy (B) (Fig 1).

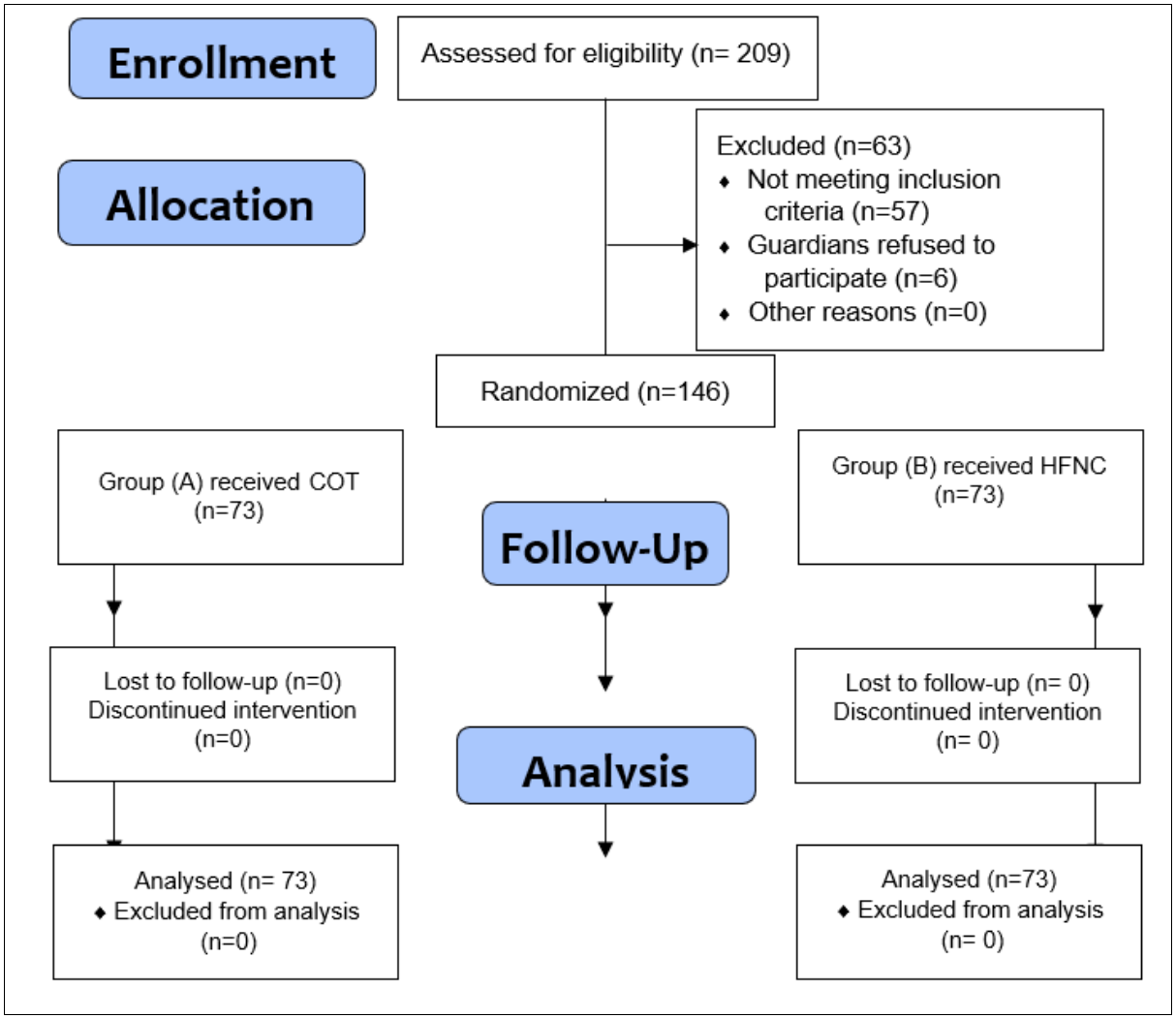

Fig 1: Flowchart of the studied group

There was statistically insignificance difference between the two groups as regard to Gender, age and BMI, LIPS, APACHE II at ICU admission, and primary diagnosis. APACHE II at discharge was a statistically significant increase in group A in comparison to group B (P. value 0.006*) (Table 1).

Table 1: Demographic data, lung injury prediction score (LIPS), APACHE II and primary diagnosis

		Group A (n = 73) (COT)	Group B (n = 73) (HFNC)	Test of sig.	P value
Sex	Male	57	55	x^2 0.153	0.695
		78.1%	75.3%		
	Female	16	18		
		21.9%	24.7%		
Age (year)	Mean ± SD	46.6 ± 9.40	48.2 ± 9.32	U 2356.0	0.220
	Range	27.0-67.0	33.0-67.0		
	Median (IQR)	46.0 (40.0-49.0)	49.0 (44.0-49.0)		
BMI (Kg/m$^{2)}$	Mean ± SD	31.5 ± 2.21	31.5 ± 2.34	t 0.999	1.000
	Range	27.0-34.0	26.0-36.0		
	Median (IQR)	31.0 (30.0-34.0)	31.0 (30.0-34.0)		
APACHE II					
At ICU admission				t 0.188	0.852
Mean ± SD		12.9 ± 0.90	12.9 ± 0.87		
Range		10.0-14.0	10.0-14.0		
Median (IQR)		13.0 (12.0-13.5)	13.0 (12.0-13.5)		
At discharge				U 2011.5	0.006*
Mean ± SD		10.1 ± 1.18	9.6 ± 0.65		
Range		9.0-12.0	9.0-11.0		
Median (IQR)		10.0 (9.0-11.0)	9.0 (9.0-10.0)		
LIPS	Mean ± SD	9.2 ± 1.61	9.4 ± 1.92	t 0.771	0.442
	Range	7.5-13.0	7.5-15.0		
	Median (IQR)	9.0 (7.5-11.0)	9.0 (8.0-11.0)		

1ry diagnosis	Abd. S	No	39	48	x^2 4.289	0.117
		%	53.4%	65.8%		
	Thoracic S	No	23	21		
		%	31.5%	28.8%		
	Neuro S	No	11	4		
		%	15.1%	5.5%		

Data are presented as mean ± SD, number (%) or median, x2: Chi square test, U, IQR: Interquartile range, COT: conventional oxygen therapy, HFNC, t: Independent t test

In terms of co-morbidities, such as diabetes, high blood pressure, heart disease, kidney disease, COPD, cirrhosis, and active cancer, there was no statistically significance difference between the two groups (Table 2).

Table 2: Comorbidities of the participants

		Group A (n=73) (COT)	Group B (n=73) (HFNC)	Test of sig.	P value
Diabetes mellitus	No	49	56	x^2 1.662	0.197
		67.1%	76.7%		
	Yes	24	17		
		32.9%	23.3%		
Hypertension	No	56	52	x^2 0.569	0.451
		76.7%	71.2%		
	Yes	17	21		
		23.3%	28.8%		
Chronic heart disease	No	51	55	x^2 0.551	0.458
		69.9%	75.3%		
	Yes	22	18		
		30.1%	24.7%		
Chronic kidney disease	No	49	52	x^2 0.289	0.591
		67.1%	71.2%		
	Yes	24	21		
		32.9%	28.8%		
Chronic obstructive pulmonary disease	No	47	51	x^2 0.497	0.481
		64.4%	69.9%		
	Yes	26	22		
		35.6%	30.1%		
Cirrhosis	No	55	49	x^2 1.203	0.273
		75.3%	67.1%		
	Yes	18	24		
		24.7%	32.9%		
Active cancer	No	40	37	x^2 0.247	0.619
		54.8%	50.7%		
	Yes	33	36		
		45.2%	49.3%		

Data are presented as and number (%), x2: Chi square test, COT, HFNC

Comparing the P/F ratio between the two studied groups after 1, 4, 12, 24, 36 hrs. Showed that there was statistically significant decrease in group A more than group B. After 36 hrs showed a statistically significant increase in group A in compared to group B (P. value <0.001*) (Table 3; Figure 2).

Table 3: Comparison between the two studied groups according to P/F ratio of the patient after 1,4,8,12,14 and 36 hrs.

ABG	Group A (n=73) (COT)	Group B (n=73) (HFNC)	Test of sig.	P value
P/F ratio after 1 hr.			U 1444.5	<0.001*
Mean ± SD	205.9 ± 4.11	210.6 ± 6.61		
Range	202.0-228.0	195.0-220.0		
Median (IQR)	205.0 (203.0-207.0)	209.0 (205.0-215.0)		
P/F ratio after 4 hr.			U 1650.0	<0.001*
Mean ± SD	212.9 ± 4.03	215.8 ± 9.80		
Range	190.0-220.0	180.0-230.0		
Median (IQR)	214.0 (212.0-215.0)	215.0 (213.0-222.0)		
P/F ratio after 8 hr.			U 996.5	<0.001*
Mean ± SD	224.2 ± 8.45	229.2 ± 14.99		
Range	187.0-229.0	180.0-238.0		
Median (IQR)	227.0 (225.5-228.0)	234.0 (232.0-238.0)		
P/F ratio after 12 hr.			U 1018.0	<0.001*
Mean ± SD	232.5 ± 9.20	234.7 ± 17.73		
Range	180.0-237.0	180.0-246.0		
Median (IQR)	235.0 (235.0-236.0)	243.0 (240.0-243.5)		

P/F ratio after 24hr.			U 784.5	<0.001*
Mean ± SD	244.9 ± 12.32	246.9 ± 19.35		
Range	207.0-250.0	180.0-258.0		
Median (IQR)	249.0 (249.0-249.0)	255.0 (251.0-257.0)		
P/F ratio after 36hr.			U 856.5	<0.001*
Mean ± SD	251.1 ± 12.09	250.8 ± 21.95		
Range	214.0-257.0	180.0-262.0		
Median (IQR)	255.0 (254.0-256.0)	260.0 (259.0-261.0)		

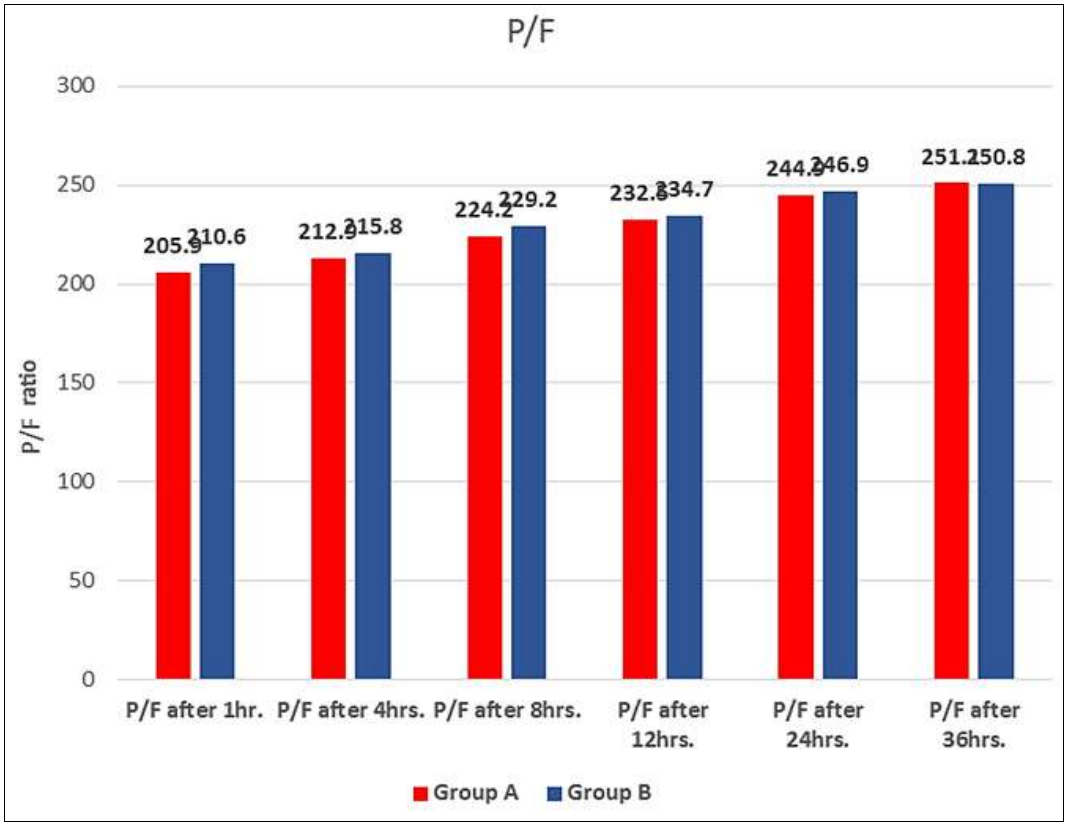

Fig 2: Comparison between the two studied groups according to P/F ratio of the patient after 1, 4, 8, 12, 14 and 36 hrs.

Comparing the Rox between the two studied groups after 6, 12 hrs. Showed a statistically significant increase in group B than group A difference between both groups (P. value 0.006*, 0.007*) respectively. While there was not statistically significance difference after 24, 36 hrs. (P. value 0.464, 0.067) respectively. [Table 4; Figure 3]

Table 4: ROX of the participants

ROX	Group A (n = 73) (COT)	Group B (n=73) (HFNC)	Test of sig.	P value
After 6 hr.			t 2.801	0.006*
Mean ± SD	4.2 ± 0.70	4.5 ± 0.70		
Range	2.9-5.3	2.9-5.6		
Median (IQR)	4.4 (4.0-4.7)	4.7 (4.15-4.9)		
After 12 hr.			t 2.760	0.007*
Mean ± SD	4.5 ± 0.81	4.9 ± 0.78		
Range	2.9-5.8	3.0-5.9		
Median (IQR)	4.8 (4.4-4.9)	5.0 (4.8-5.2)		
After 24 hr.			t 0.734	0.464
Mean ± SD	5.0 ± 1.10	5.2 ± 0.91		
Range	2.9-6.2	3.0-6.2		
Median (IQR)	5.5 (4.65-5.925)	5.4 (5.1-5.8)		

Data are presented as mean ± SD, number (%) or median, t: Independent t test, COT: conventional oxygen therapy HFNC: High-flow nasal cannula, *p ≤ 0.05 (Statistically significant)

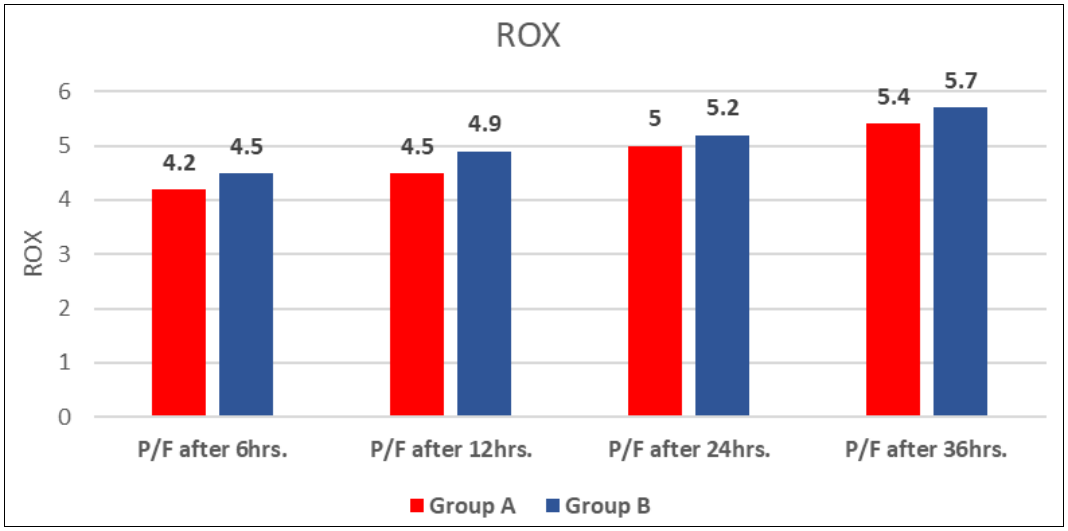

Fig 3: Comparison between the two studied groups according to ROX of the patient after 6,12,24 and 36 hrs.

There was a statistically significant increase in group A compared to group B as regard to post-operative respiratory failure (P. value 0.044*). Comparing the time of reintubation between the two studied groups showed that there was a statistically significant decrease in group A (COT) compared to group B (HFNC) as the time range to reintubation for group A is (10.0-13.0) compared to (12.0-16.0) in group B (P. value 0.001). There was statistically insignificant difference between the two groups (P. value 0.630) as regard to reason to reintubation. The reasons of reintubation were:

1. **Persistent hypoxia:** the percentage of persistent hypoxia is 29.4% in Group A (COT) Compared to 25.0% in Group B (HFNC).
2. **Tachypnea:** The percentage of tachypnea is 17.6% in Group A (COT) Compared to 25.0% in Group B (HFNC). Hemodynamic instability: The percentage of hemodynamic instability and adding vasopressor is 5.9% in group A (COT) compared to 25.0% in group B (HFNC).
3. **Retained secretion:** The percentage of Retained secretion is 29.4% in group A (COT) Compared to 12.5% in group B (HFNC).
4. **DCL:** The percentage of Disturbance conscious level is 17.6% in group A (COT) Compared to 12.5% in group B (HFNC). (Table 5).

Table 5: Reintubation data of the participants

	Group A (COT)	Group B (HFNC)	Test of sig.	P value
Rate of Reintubation (Post-Operative Respiratory Failure				
No	60/73	68/73	x^2 4.056	0.044*
	82.2%	93.2%		
Yes	13/73	5/73		
	17.8%	6.8%		
Time to reintubation (hr)				
Mean ± SD	11.1 ± 1.11	14.0 ± 1.77	U 12.0	<0.001*
Range	10.0-13.0	12.0-16.0		
Median (IQR)	11.0 (10.0-12.0)	14.5 (12.0-15.75)		
Reasons to reintubation				
Persistent hypoxia	5	2	MC	0.630
	29.4%	25.0%		
Tachypnea	3	2		
	17.6%	25.0%		
Hemodynamic instability and adding vasopressor	1	2		
	5.9%	25.0%		
Retained secretion	5	1		
	29.4%	12.5%		
Disturbance conscious level	3	1		
	17.6%	12.5%		
	17.8%	6.8%		

Table 6 showed that there was a statistically significant increase in group A compared to group B regard ICU and HLS as the ICU Stay range of group A was (3.0-9.0) Compared to (3.0-6.0) in group B (P. value <0.001), while as the HLS range of Group A (COT) was (3.0-12.0) compared to (3.0-10.0) in Group B (HFNC) (P. value <0.001). The Hospital Mortality percentage was 4.1% (3 patients) in Group A (COT) and 2.7% (2 patients) in Group B (HFNC) with no significance difference statistically (Table 6).

Table 6: ICU & Hospital length Stay and Number of hospital mortality of the participants of the participants.

		Group A (n = 73) (COT)	Group B (n = 73) (HFNC)	Test of sig.	P value
ICU (days)	Mean ± SD	5.9 ± 1.90	4.3 ± 1.07	t 6.564	<0.001*
	Median (IQR)	6.0 (4.0-7.0)	4.0 (3.0-5.0)		
Hospital length Stay (days)	Mean ± SD	7.8 ± 2.29	6.9 ± 1.60	t 2.512	0.013*
	Median (IQR)	8.0 (6.0-10.0)	7.0 (6.0-8.0)		
Hospital mortality					
Number of patients	No	70	71	FE	1.000
		95.9%	97.3%		
	Yes	3	2		
		4.1%	2.7%		

Data are presented as mean ± SD, number (%) or median, FE: Fischer Exact test, COT: conventional oxygen therapy HFNC: High-flow nasal cannula

Discussion

Postoperative pulmonary problems increase the risk of respiratory failure and the need for reintubation, which in turn leads to unexpected admission to the intensive care unit. This is related with a 9-fold increase in postoperative mortality and places a greater financial burden on healthcare systems [7].

HFNC delivers a greater amount of oxygen at a faster rate, which reduces the amount of unused space in the respiratory system by limiting the inhalation of exhaled air and maintains a positive pressure at the conclusion of exhalation [8].

Concerning to the time to reintubation in hours of the participants and the reasons of reintubation (Persistent hypoxia, Tachypnea, Hemodynamic instability and adding vasopressor, retained secretion and Disturbance conscious level) and post-operative respiratory failure in our study: There was statistically significant difference between the two groups.

HFNC provides a higher and more consistent level of oxygenation as it delivers up to 100% humidified and warmed oxygen at a flow rate that can exceed the patient's peak inspiratory flow rate. This ensures a more stable fraction of inspired oxygen and reduces the work of breathing. Improved oxygenation can delay the clinical signs of respiratory failure that would necessitate reintubation [9].

In accordance to our results Youfeng Zhu, *et al*., [2] who carried out a meta-analysis that Conducted a comparative study on HFNC oxygen treatment and COT in patients after scheduled extubation. A total of ten studies, consisting of seven randomized controlled trials (RCTs) and three crossover studies, were included into the analysis. The HFNC group comprised 856 patients, whereas the COT group consisted of 852 patients. HFNC has been shown to dramatically decrease postextubation respiratory failure when compared to COT. In contrary to our results, Zhonghua Lu *et al*., [10]. Compared the effects of HFNC oxygen therapy to COT on retabulation rates, respiratory support escalation, and postoperative pulmonary complications (PPCs) in a meta-analysis. The incidence of PPCs or mortality rates are not different. The large sample size (a total of 1327 postextubation adult surgical patients, of which 615 patients received HFNC and 712 received COT), and the clinical heterogeneity between trials included in their systematic review and meta-analysis may explain this difference.

Our results showed that regarding APACHE II upon ICU admission, there was no statistically significant difference between the two groups. However, when it came to APACHE II score at release, there was a statistically significant difference. The APACHE II score ranges from 0 to 71, with higher scores indicating a greater likelihood of mortality in the hospital. An benefit of the APACHE system is its ability to continuously assess a patient's reaction to treatment during their hospital stay. The APACHE II's accuracy upon admission as an early predictive indication of illness severity is around 75%. The calculation of APACHE II points included summing the preceding 12 points, referred to as A. Age points were assigned based on the following criteria: ≤44 years = 0 points, 45 to 54 years = 2 points, 55 to 64 years = 3 points, 65 to 74 years = 5 points, and ≥75 years = 6 points, denoted as B. Chronic Health Points were denoted as C. Compute the cumulative APACHE II score by summing the scores obtained from categories A, B, and C [11].

Similar to our results, Woo Hyun Cho *et al*., [12] reviewed that the medical records of patients experiencing acute hypoxemic respiratory failure and receiving HFNC treatment in the medical critical care unit. Therapy success was determined by the ability to prevent the need for intubation. Out of the 75 eligible patients, 62.7% effectively prevented the need for intubation. Following the correction for other clinical factors, it was shown that Acute Physiology and Chronic Health Evaluation II (APACHE II), Sequential Organ Failure Assessment (SOFA), cardiogenic pulmonary edema, and improvement in PaO2 at 1 and 24 hours were linked to the efficacy of the treatment.

Comparing the P/F ratio between the two studied groups after 1, 4, 12, 24, 36 hrs. showed that there was statistically significant reduction in group A more than group B. after 36 hrs, there was high statistically significant difference in group A in compared to group B (P. value <0.001*).

In the early stages after initiation (1, 4, 8, 12, 24 hours), the P/F ratio is often higher in patients using HFNC compared to those on conventional oxygen therapy as HFNC generates a low level of positive airway pressure, helping to keep alveoli open, reduce atelectasis, and improve gas exchange [13]. Also, HFNC washes out carbon dioxide from the upper airways, reducing dead space ventilation and improving overall gas exchange [14]. However, lower P/F ratio in HFNC patients after 36 hours could be due to HFNC can mask signs of respiratory failure, leading to delayed interventions such as escalation to mechanical ventilation [15]. The initial improvement might give a false sense of security, and underlying respiratory issues might not be addressed timely. Over time, the patient's disease may progress, making them less responsive to HFNC. Conditions like ARDS, pneumonia, or other pulmonary complications can worsen, reducing lung compliance and gas exchange [16].

Additionally, over time, patients might develop discomfort or intolerance to HFNC, leading to issues with mask fit and leakage, which can decrease the effectiveness of the therapy [17].

In agreement to our study, Youfeng Zhu *et al*., [2], Conducted a meta-analysis comparing the effectiveness of HFNC oxygen treatment with COT in patients after scheduled removal of a
breathing tube.

Comparing the Rox between the two studied groups after 6, 12 hrs. Showed that there was higher statistically significant in group B than group A difference between both groups (P. value 0.006*, 0.007*) respectively. While there was not statistically difference after 24, 36 hrs. (P. value 0.464, 0.067) respectively.

The comfort and improved oxygenation provided by HFNC can lead to a more significant reduction in the respiratory rate in the initial hours. HFNC may mask signs of respiratory distress due to its comfort and efficiency in oxygen delivery. This can lead to a delay in escalating care or recognizing the need for mechanical ventilation in patients whose condition deteriorates [18].

Our results are in accordance with Maulin Patel *et al*., [19] A study discovered that 129 patients with acute hypoxemic respiratory failure caused by COVID-19 pneumonia were originally treated with HFNT via a retrospective assessment. Among this group, 89 patients continued to receive High-Flow Nasal Therapy (HFNT), whereas 40 patients ultimately needed Invasive Mechanical Ventilation (IMV). All 89 patients who were treated with HFNT as a means to facilitate recovery saw a significant increase in their ROX levels from the start of HFNT treatment, as seen at all documented time intervals. Conversely, the ROX score for patients who eventually needed intubation remained stable or declined with time.

Comparing The ICU Stay and The HLS between the two studied groups showed that there was statistically significant difference.

The use of HFNC resulted in shorter ICU and hospital stays compared to COT, due to several causes. HFNC enhances oxygenation and ventilation by delivering high-flow, humidified oxygen [20], which aligns better with a patient's respiratory demands, leading to quicker patient stabilization and potentially shorter ICU durations. It reduces the respiratory workload and dead space in the respiratory tract, contributing to faster recovery from respiratory distress [21]. HFNC's increased comfort compared to traditional oxygen delivery methods like face masks improves patient compliance and reduces complications, potentially shortening hospital stays [22]. Additionally, HFNC can diminish the need for escalation to mechanical ventilation which is associated with longer ICU stays and more complications. It may also lower the risk of hospital-acquired infections and enables earlier mobilization and rehabilitation [23], further reducing hospitalization duration.

In contrary to our results, Youfeng Zhu, *et al*., [2]. Conducted a meta-analysis comparing the effectiveness of HFNC oxygen treatment with COT in patients after scheduled extubation. A total of ten studies, consisting of seven randomized controlled trials (RCTs) and three crossover studies, were included into the analysis. The HFNC group comprised 856 patients, whereas the COT group consisted of 852 patients. Indicated that there were no notable disparities in the duration of intensive care unit (ICU) and hospitalization. Different study designs and different sample size may be responsible for these differences.

In contrary to our results, Dipayan *et al*., [24] found a meta-analysis that showed HFNC Compared with Non-invasive Positive Pressure Ventilation in Acute Hypoxic Respiratory Failure: they reviewed 499 citations and included nine RCTs. there was likely no difference in ICU or hospital length of stay. This difference may be attributed to larger sample size.

Comparing the hospital mortality between the two studied groups showed that there was statistically insignificant difference.

In agreement to our, Youfeng Zhu *et al*., [2] Conducted a comprehensive study and synthesis of existing research that examined the effectiveness of HFNC oxygen treatment compared to traditional oxygen therapy in patients after scheduled removal of a breathing tube. A total of ten studies were included in the analysis, consisting of seven randomized controlled trials (RCTs) and three crossover studies. The HFNC group included 856 patients, whereas the COT group consisted of 852 individuals. Indicated that there were no statistically significant disparities in hospital mortality. The current results are in the same line with François Stéphan *et al*., [25] Researchers that investigated hypoxemia after cardiothoracic surgery compared the effects of non-invasive positive airway pressure with high-flow nasal oxygen. The most common cardiothoracic surgeries performed on 830 patients were pulmonary thromboendarterectomy, valvular correction, and coronary artery bypass. Mortality rates in intensive care units did not vary much.

Moreover, Jun Duan *et al*., [26] Observed COVID-19 patients across many centres to see how they responded to HFNC and non-invasive breathing techniques. There was a total of 33 COVID-19 patients who were first treated with HFNC and 13 patients who were initially treated with NIV. The enrollment was completed after the fact. The negative pressure ward admitted 35 patients out of the total number of registered patients, while the intensive care unit (ICU) took one patient. As a first line of therapy, 23 patients got HFNC and 13 underwent NIV. Furthermore, there was no discernible disparity in death rates between the two groups. Our study had limitations as Single study of 2 units ICU (not generalized) and non-blind trial.

Conclusions

Post-Surgical Patient at high risk of ALI, the use of Immediate HFNC compared to COT reduce the reintubation rate.

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Conflict of Interest

Nil.

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