OUTCOME OF NON INVASIVE POSITIVE PRESSURE VENTILATION IN MANAGEMENT OF ACUTE RESPIRATORY DISTRESS IN PEDIATRIC ICU IN BAB EL SHAEREYA UNIVERSITY HOSPITAL

By

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ABSTRACT

Introduction: *Acute respiratory distress is one of the most common pediatric emergencies. In fact, it is a very common symptom between a lot of diseases. Oxygen therapy remains the most important treatment of all causes of respiratory distress.*

Aim of work: *Evaluation the usefulness of non invasive continuous positive airway pressure (n CPAP) in conditions of respiratory distressed infants & children in comparison to conventional O2 therapy (nasal pronge, oxygen mask, venturi mask).*

Patients and methods: *the study was conducted on 100 infants and children between 1 month and 5 years old having nearly the same causes of respiratory distress in Bab El Shaerea University hospital. They were divided into two groups, group I (50 patients) treated by n CPAP, and group II (50 patients) treated by conventional O2 therapy, and evaluated after 48 hours by ABG and clinically using PRISM score, CRS score and asthma score.*

Results of the study*: showed that there was statistically significant improvement in ABG finding in group I more than group II after 48 hours of oxygen therapy. Also, duration of oxygen therapy and hospital stay was statistically significant less in group I. Clinically, the improvement in group I was more significant than group II. Asthma patients showed no difference in asthma score in both groups.*

Conclusion: *CPAP was associated with improved respiratory rate and decreased morbidity & mortality in children younger than 5 years with undifferentiated respiratory distress. There were fewer serious adverse events. CPAP was associated with more improvement in ABG finding, less hospital stay and shorter duration of O2 treatment than conventional O2 therapy.*

Recommendations: *more studies should be done on asthmatic patients to identify if there is an upper hand of CPAP over conventional O2 therapy in asthma treatment.*

Key words: *respiratory distress, n CPAP, conventional O2 therapy.*

INTRODUCTION

Acute respiratory distress is one of the most common pediatric emergencies. Respiratory distress signifies potential respiratory failure. Any infant or child, who has difficulty in breathing, characterized by excessive work of the muscles of respiration, is said to be in respiratory distress. It is equivalent to the symptom of dyspnea in an older child who is able to communicate this subjective symptom which is defined as 'abnormal uncomfortable awareness of breathing' ***(Pasterkamp, 2006)***.

However, dyspnea and respiratory distress are not exactly synonymous as in some metabolic causes of respiratory distress such as metabolic acidosis and in cyanotic congenital heart diseases; there may not be dyspnea even though child is in respiratory distress. Respiratory distress may be acute or chronic. Acute respiratory distress is more easily recognized by the clinician where as chronic respiratory distress is often overlooked ***(Anderson, 2003)***.

PATIENTS AND METHODS

The study was carried out as cross sectional case control study on 100 children admitted to pediatric ICU, *Bab El Shaereya Hospital, Al Azhar University* with acute respiratory distress (ARD) over a period of 16 months, in the time period from September 2016 to December 2017.

- They were selected by simple random method. There were divided into two groups:
  1. **Group I:** 50 patients with respiratory distress managed by non invasive CPAP.
  2. **Group II:** 50 patients with respiratory distress managed by conventional O2 therapy (nasal pronge, oxygen mask, venturi mask).

Inclusion criteria:

1. Age between 1 month and 5 years.
2. Oxygen saturation > 85% in room air.
3. Spontaneous breathing.

Exclusion criteria:

1. Age < 1 month and > 5 years.

2. Oxygen saturation <85% in room air
3. Haemodynamic instability.
4. Serious cardiac arrhythmias.
5. Unconscious patients.
6. Need for endotracheal intubation on admission.
7. Inability to properly fit the facemask due to skeletal deformity traumatisms, and facial burns.

Sampling

All patient**s** were randomly rotated between both groups and undergo the following:

- **Thorough history** includes:
  - ***Personal history***: name, age, sex, residency, consanguinity and order of sibling.
  - ***History of present illness***: onset, course, duration, association, what increases, what decreases and other systems associated symptoms.
  - ***Past history***: similar condition, drugs, operations, previous admission and any other diseases.
  - ***Family history***: consanguinity, familial diseases, similar condition in other family member.
- **Full examination** which includes:
  - ***General examination***: general condition, head, neck, abdomen, back, upper limps, lower limps, heart rate, respiratory rate, Spo2, temperature, blood pressure and color.
  - ***Local examination***: inspection, palpation, percussion and auscultation.
- **Investigations**:
  - ***Lab***: CBC, CRP, ABG (before and after O2 therapy) and serum creat. ***(walk, et al. 2014)***.
  - ***X ray chest (Papadopoulos, et al. 2002).***
- **Evaluation** of improvement and outcome through three scores:
  1. ***PRISM score*** (the pediatric risk of mortality) ***(Sayed, et al.2017).***
  2. ***CRS score*** (clinical respiratory score) (***Kushida, et al. 2008)***.
  3. Asthma score for asthma patients only (Kakkar, et al. 2009).

All scores were applied before, 12 hours, 24 hours and 48 hours of O2 therapy.

Steps of research:

1. Approval of ethical committee of the department, college and university was obtained.

2. Informed consent was taken from all patients included in the study.
3. No conflict of interest in the study.
4. Devices and procedures:
   - ♦ Bubbling CPAP was used as continuous positive airway pressure in group I, while group II was treated by conventional O2 therapy.
   - ♦ Non-vented masks interface were used in patients more than 1 year, while nasal CPAP was used in patients less than 1 year in group I.
   - ♦ In group II, either nasal pronge, O2 mask or venturi mask were used.
   - ♦ Proper sedation was administered to all patients on CPAP to improve mask tolerance and adaptation, according to medical criteria.
   - ♦ Naso-gastric tube decompression was used with all patients.
   - ♦ Some patients remained without enteral feedings until stabilization of their condition.
   - ♦ All patients received continuous monitoring of the electrocardiograph, pulse oximetry, O2 saturation and RR.

5. Assessment of predictors:

Prediction of success or failure of non invasive ventilation (NIV) was assessed by clinical, hemo-dynamic, arterial blood gases analysis and the previously mentioned scores.

RESULTS

Table (1): Comparison between group I and group II regarding demographic data.

		Group I	Group II	Test value	P-value	Sig.
		No. = 50	No. = 50			
Age (ys)	Mean ± SD	1.11 ± 0.82	1.01 ± 0.78	0.616•	0.539	NS
	Range	0.17 – 2.5	0.17 – 2.5			
Sex	Females	12 (24.0%)	13 (26.0%)	0.053*	0.817	NS
	Males	38 (76.0%)	37 (74.0%)			

> 0.05 NS: Non significant; < 0.05 S: Significant; < 0.01 HS: Highly significant
*:Chi-square test; •: Independent t-test

The previous table shows that there was no statistically significant difference between group I and group II regarding age and sex

Table (2): Comparison between group I and group II regarding anthropometric measures according to standard deviation.

Anthropometric measures		Group I		Group II		Test value*	P-value	Sig.
		No.	%	No.	%			
Length	Normal	48	96.0%	49	98.0%	0.344	0.558	NS
	Short	2	4.0%	1	2.0%			
Weight	Normal	48	96.0%	47	94.0%	0.344	0.842	NS
	Overweight	1	2.0%	1	2.0%			
	Underwt.	1	2.0%	2	4.0%			
H.C.	Macrocephaly	2	4.0%	1	2.0%	0.667	0.717	NS
	Microcephaly	1	2.0%	2	4.0%			
	Normal	47	94.0%	47	94.0%			

NS: Non significant; S: Significant; HS: Highly significant *:Chi-square test.

The previous table shows no statistically difference between group I and group II regarding anthropometric measures according to standard deviation.

Table (3): Comparison between group I and group II regarding laboratory data.

		Group I	Group II	Test value	P-value	Sig.
		No. = 50	No. = 50			
Hb (mg/dl)	Mean±SD	9.43 ± 0.32	9.43 ± 0.35	0.000•	1.000	NS
	Range	8.7 – 11.4	8.5 – 11.6			
WBC	Mean±SD	18.92 ± 3.41	17.84 ± 4.03	1.446•	0.151	NS
	Range	13 – 25	10.9 – 23			
Plt.	Mean±SD	243.90 ± 83.67	229.60 ± 85.44	0.846•	0.400	NS
	Range	144 – 401	133 – 375			
CRP	Negative	25 (50.0%)	25 (50.0%)	0.000*	1.000	NS
	Positive	25 (50.0%)	25 (50.0%)			
Serum Creat.	Mean±SD	0.77 ± 0.09	0.78 ± 0.09	-1.020•	0.310	NS
	Range	0.4 – 1.2	0.4 – 1.2			

NS: Non significant; S: Significant; HS: Highly significant

*:Chi-square test; •: Independent t-test

The previous table shows that there was no statistically significant difference between group I and group II regarding laboratory data.

Table (4): Comparison between group I and group II regarding arterial blood gases before and after oxygen therapy

ABG		Group I		Group II		P1••	P2••	P3•	P4•
		Before	After	Before	After				
PH	Mean±SD	7.29 ± 0.07	7.32 ± 0.04	7.29 ± 0.08	7.32 ± 0.02	0.016	0.025	0.979	0.676
	Range	7.13 – 7.52	7.21 – 7.45	7.13 – 7.52	7.30 – 7.33				
CO2	Mean±SD	45.48 ± 10.24	36.48 ± 8.24	45.54 ± 9.02	39.06 ± 2.02	0.000	0.000	0.975	0.034
	Range	27 – 61	31 – 59	27 – 61	36 – 41				
HCO3	Mean±SD	19.32 ± 3.91	21.10 ± 1.22	19.43 ± 3.65	24.5 ± 0.71	0.003	0.000	0.885	0.000
	Range	13 – 28	20 – 23	13 – 28	23 – 26				
O2	Mean±SD	87.0 ± 1.01	91.20 ± 2.03	87.6 ± 2.46	95.58 ± 2.34	0.000	0.000	0.114	0.000
	Range	86 – 88	85 – 94	85 – 94	85 – 98				

NS: Non significant; S: Significant; HS: Highly significant
•: Independent t-test; ••: Paired test
P1: Comparison between before and after in group I
P2: Comparison between before and after in group II
P3: Comparison between group I and group II before
P4: Comparison between group I and group II after

The previous table shows that there was no statistically significant difference between group I and group II regarding arterial blood gases before oxygen therapy on admission. While there was statistically significant difference between group I and group II regarding arterial blood gases after oxygen therapy for 48 hrs. Also there was statistically

significant difference at group I before and after 48 hrs of oxygen therapy. The same happened in group II.

Table (5): Comparison between group I and group II regarding X ray finding.

X ray finding	Group I		Group II		Test value*	P-value	Sig.
	No.	%	No.	%			
Increased Broncho-vascular marking	32	64.0%	31	62.0%	0.107	0.991	NS
Multiple patches	5	10.0%	6	12.0%			
Normal	12	24.0%	12	24.0%			
Right upper lobe patch	1	2.0%	1	2.0%			

NS: Non significant; S: Significant; HS: Highly significant
*:Chi-square test

The previous table shows that there was no statistically significant difference between group I and group II regarding **x** ray finding.

Table (6): Comparison between group I and group II regarding cause of respiratory distress.

Cause of RD	Group I		Group II		Test value *	P-value	Sig.
	No.	%	No.	%			
Bronchial asthma	18	36.0%	16	32.0%	0.227	0.973	NS
Bronchiolitis	26	52.0%	27	54.0%			
Bronchopneumonia	5	10.0%	6	12.0%			
Pneumonia	1	2.0%	1	2.0%			

NS: Non significant; S: Significant; HS: Highly significant *:Chi-square test

The previous table shows that there was no statistically significant difference between group I and group II regarding cause of RD.

Table (7): Comparison between group I and group II regarding RD clinical symptoms.

RD clinical symptoms		Group I		Group II		P1	P2	P3	P4
		Before	After	Before	After				
RR	Mean±SD	63.74 ± 12.92	45.26 ± 4.98	62.96 ± 12.62	51.90 ± 4.87	0.000••	0.000••	0.761•	0.000•
	Range	44 – 92	37 – 55	44 – 92	45 – 66				
Retraction	Absent	0 (0.0%)	46 (92.0%)	0 (0.0%)	39 (78.0%)	0.000*	0.000*	NA	0.050*
	Present	50 (100.0%)	4 (8.0%)	50 (100.0%)	11 (22.0%)				
Air entry	Diminished	39 (78.0%)	4 (8.0%)	40 (80.0%)	13 (26.0%)	0.000*	0.000*	0.806	0.017*
	Normal	11 (22.0%)	46 (92.0%)	10 (20.0%)	37 (74.0%)				
Wheezes	Absent	3 (6.0%)	46 (92.0%)	3 (6.0%)	37 (74.0%)	0.000*	0.000*	0.806*	0.017*
	Present	47 (94.0%)	4 (8.0%)	47 (94.0%)	13 (26.0%)				
Grunting	Absent	0 (0.0%)	47 (94.0%)	0 (0.0%)	43 (86.0%)	0.000*	0.000*	1.000*	0.182*
	Present	50 (100.0%)	3 (6.0%)	50 (100.0%)	7 (14.0%)				

NS: Non significant; S: Significant; HS: Highly significant *: Chi- square test;
•: Independent t-test; ••: Paired test
P1: Comparison between before and after in group I
P2: Comparison between before and after in group II
P3: Comparison between group I and group II before
P4: Comparison between group I and group II after

The previous table shows that there was no statistically significant difference between group I and group II regarding RD clinical symptoms on admission. While there was statistically significant difference found between group I and group II regarding RD clinical symptoms after 48 hrs of O2 therapy. Also, there was statistically significant difference found at group I between before and after 48 hrs of therapy. The same happened with group II.

Table (8): Comparison between group I and group II regarding duration of O2 therapy and hospital stay.

		Group I	Group II	Test value•	P-value	Sig.
		No. = 50	No. = 50			
Duration of O2 therapy by hour	Mean±SD	44.40 ± 7.76	63.60 ± 15.38	-7.880	0.000	HS
	Range	36 – 60	36 – 96			
Hospital stay	Mean±SD	5.11 ± 1.29	7.30 ± 1.76	-7.092	0.000	HS
	Range	4 – 9	5 – 13			

NS: Non significant; S: Significant; HS: Highly significant •: Independent t-test

The previous table shows that there was statistically high significant difference between group I and group II regarding duration of O2 therapy by hour and hospital stay.

Table (9): Comparison between group I and group II regarding PRISM score.

PRISM		Group I
		No. = 50
On admission	Mean±SD	0.00 ± 0.00
	Range	0 – 0
12 hr	Mean±SD	0.00 ± 0.00
	Range	0 – 0
24 hr	Mean±SD	0.00 ± 0.00
	Range	0 – 0
48 hr	Mean±SD	0.00 ± 0.00
	Range	0 – 0

NS: Non significant; S: Significant; HS: Highly significant

The previous table shows that there was no statistically significant difference between group I and group II regarding PRISM score.

Table (10): Comparison between group I and group II regarding CRS score.

CRS score		Group I No. = 50	Group II No. = 50	Test value•	P-value	Sig.
On admission	Mean±SD Range	5.78 ± 0.79 5 – 7	5.72 ± 0.76 5 – 7	0.388	0.699	NS
12 hr	Mean±SD Range	3.54 ± 0.65 3 – 6	4.50 ± 1.02 4 – 9	-5.642	0.000	HS
24 hr	Mean±SD Range	2.50 ± 0.54 2 – 4	3.52 ± 0.91 2 – 7	-6.809	0.000	HS
48 hr	Mean±SD Range	1.50 ± 0.54 1 – 3	2.44 ± 0.71 2 – 6	-7.468	0.000	HS

NS: Non significant; S: Significant; HS: Highly significant •: Independent t-test

The previous table shows that there was no statistically significant difference between group I and group II regarding CRS score on admission. While there was statistically high significant difference found between group I and group II regarding RD score after 12 hrs, 24hrs and 48 hrs.

Table (11): Comparison between group I and group II regarding asthma score.

Asthma score		Group I No. = 50	Group II No. = 50	Test value•	P-value	Sig.
On admission	Mean±SD Range	5.36 ± 0.51 5 – 6	5.43 ± 0.51 5 – 6	-0.316	0.755	NS
12 hr	Mean±SD Range	3.55 ± 0.52 3 – 4	3.64 ± 0.50 3 – 4	-0.476	0.639	NS
24 hr	Mean±SD Range	1.45 ± 0.52 1 – 2	1.36 ± 0.50 1 – 2	0.476	0.639	NS
48 hr	Mean±SD Range	1.00 ± 0.00 1 – 1	1.00 ± 0.00 1 – 1	NA	NA	NA

NS: Non significant; S: Significant; HS: Highly significant •: Independent t-test

The previous table shows that there was no statistically significant difference between group I and group II regarding asthma score.

Table (12): Comparison between group I and group II regarding outcome.

Outcome	Group I		Group II		Test value*	P-value	Sig.
	No.	%	No.	%			
Deterioration	4	8.0%	7	14.0%	2.112	0.348	NS
Died	1	2.0%	3	6.0%			
Improved	45	90.0%	40	80.0%			

NS: Non significant; S: Significant; HS: Highly significant *:Chi-square test.

The previous table shows that there was no statistically significant difference between group I and group II regarding outcome.

DISCUSSION

Respiratory distress in pediatrics is a major symptom caused by a lot of diseases such as bronchiolitis, bronchial asthma, pneumonia or bronchopneumonia. It may be mild, moderate or severe. If management of mild and moderate cases started early, good prognosis can be achieved (***Muhe, 2001).***

In severe cases invasive ventilation is required to achieve best prognosis, while, in mild & moderate cases we can use either conventional oxygen therapy or continuous positive airway pressure (***Shoemaker, 2007***).

As regard demographic data in table (1), anthropometric measures in table (2), laboratory data in table (3), x-ray finding in table (5) and cause of respiratory distress in table (6), the two groups were nearly the same. That is so important for results to be valuable, as if there was any significant difference between the two groups on admission, then, we could not consider the results.

As regard ABG finding in table (4), both groups were nearly the

same on admission, but after 48 hours, CPAP group showed more improvement in CO2 concentration, which means that CO2 wash, is better with CPAP, because CPAP provides positive pressure all the way along respiratory cycle causing better aeration of the lungs and better gas exchange. This is in agreement with ***Matthew, 2011*** who conducted a systematic review of the use of CPAP in acute bronchiolitis where both randomized and observational studies were included. This review reported that CPAP reduced PCO_2.

As regard table (7) and table (10), there was statistically significant improvement in group I than group II in clinical signs of respiratory distress and consequently CRS score after 48 hours of O2 therapy. And this is a result of continuous pressure of CPAP on both lungs during respiratory cycle causing splinting of collapsed bronchioles and improving lung aeration so, relieves the compensatory mechanism done by the stressed child (grunting). This is in agreement with ***Howson, 2012*** who stated that CPAP was associated with rapid improvement of clinical symptoms.

As regard duration of O2 therapy and hospital stay in table (8), CPAP group needed fewer hours on O2 treatment, and consequently, less hospital stay. This is in agreement with ***Robin, 2016*** who found that CPAP reduces post- operative hospital stay.

As regard PRISM score in table (9), there was no statistically significant difference between the two groups.

As regard asthma score in table (11), there was no statistically significant difference between the two groups in asthma score, so, more studies should be done in more asthmatic patients to rule out the role of CPAP in asthma.

As regard the outcome in table (12), there was no statistically significant difference between the two groups, although, group I showed better outcome than group II in number of improved patients.

Our study showed that CPAP is a better tool of delivering O2 than conventional O2 therapy in respiratory distressed infants and children not complicated by a cardiac or neural problem.

CONCLUSIONS

In conclusion, CPAP was associated with improved respiratory rate and decreased morbidity & mortality in children younger than 5 years with undifferentiated respiratory distress. Actually, it

was better than conventional O2 therapy. There were fewer serious adverse events. Most of distressed infants and children had improvements in their respiratory status and functions.

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تأثير التهوية الغير غازية بالضغط الإيجابى فى علاج الضائقة التنفسية بوحدة العناية المركزة للأطفال بمستشفى باب الشعرية الجامعى

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تعتبر الضائقة التنفسية واحدة من أهم حالات الطوارئ فى الأطفال. فى الواقع هى عرض مشترك بين عدة أمراض. يعتبر العلاج بالأكسجين هو أهم علاج لكل مسببات الضائقة التنفسية.

الهدف من البحث: هو تقييم فوائد العلاج بالأكسجين عن طريق الضغط الإيجابى الغير غازى فى حالات الضائقة التنفسية فى الأطفال مقارنة بدور الأكسجين المقدم بالطرق العادية.

المرضى وطرق العلاج: شملت الدراسة 100طفل بين عمر شهر و 5 سنوات و الذين يعانون تقريبا من نفس أسباب الضائقة التنفسية بمستشفى باب الشعرية الجامعى. و قد تم تقسيمهم إلى مجموعتين: المجموعة الأولى(50 طفل) يتم علاجهم بالضغط الإيجابى غير الغازى , والمجموعة الثانية (50 طفل) يتم علاجهم بالأكسجين المقدم بالطرق العادية, على أن يتم تقييمهم بعد 48 ساعة بتحليل غازات الدم وأيضا إكلينيكيا بإستخدام بريزم سكور و كلينيكال ريسبيراتورى سكور و أزما سكور.

نتائج البحث: هناك فرق إحصائى واضح فى تحسين نتائج تحليل غازات الدم فى المجموعة الأولى بشكل أكبر من المجموعة الثانية بعد 48 ساعة من العلاج بالأكسجين. كما كان هناك فترة أقل فى المجموعة الأولى مقارنة بالثانية فى العلاج بالأكسجين و فترة الإقامة بالمستشفى. كما كان هناك تحسنا إكلينيكيا واضحا فى المجموعة الأولى مقارنة بالثانية. و لكن مرضى الربو لم يظهروا أى فروق فى الأزما سكور بعد 48 ساعة من العلاج.

خلاصة البحث: علاج الأكسجين بالضغط الإيجابى كان مصاحبا بتحسن معدلات التنفس وقل معه المرضى و الوفيات فى الأطفال أقل من 5 سنوات. كان هناك نسبة بسيطة من الأعراض الجانبية. و قد كان علاج الأكسجين بالضغط الإيجابى مصاحبا بتحسن ملحوظ بنتائج تحليل غازات الدم, و معدل بقاء أقل فى المستشفى و استخدام الأكسجين لفترة أقل.

التوصيات: نوصى بعمل دراسات على عدد أكبر من مرضى الربو الشعبى للتأكد ما إذا كان هناك أهمية واضحة لعلاج الأكسجين بالضغط الإيجابى لهذه الحالات عن علاج الأكسجين بالطرق العادية.