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Clinical Audit on the Use of Continuous Positive Airway Pressure in Neonatal Intensive Care Unit of Assiut University Children Hospital

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Abstract

Background: Continuous Positive Airway Pressure (CPAP) is a well-established mode of respiratory support in preterm newborns. We aim by this study to assess adherence of medical staff to the guidelines and adapted protocols of using CPAP.

Aim of Study: To assess the application of medical staff for the guidelines and adapted protocols of using CPAP in Neonatal Intensive Care Unit at Assuit University Children Hospital.

Patients and Methods: This study is a prospective observational analysis of hospital admission of neonates receiving CPAP care in the Neonatal Intensive Care Unit in Assuit University Children Hospital.

Results: Outcome of CPAP use was good as improvement of cases occurred in 58.3 % of cases and failed in 41.7% of cases.

Conclusion: Data of the study showed that using CPAP for cases of respiratory distress in neonatal Intensive Care Unit in Assiut University Children Hospital partially followed the reference standard of the study.

Key Words: *Continuous positive airway pressure – Neonatal respiratory distress – Newborn – Respiratory distress syndrome – Mechanical ventilation.*

Introduction

CONTINUOUS Positive Airway Pressure (CPAP) is a well-established mode of respiratory support in preterm newborns. Advancement in technology, increasing survival of extremely preterm newborns and better understanding of various respiratory diseases led to new evidence in this field over last decade. It is important to update ourselves on the recent changes in the practice of CPAP and its implications for resource-limited settings [1].

Current modalities of ventilatory assistance in the management of respiratory distress in infants range from Continuous Positive Airway Pressure (CPAP) to various modes of mechanical ventilation. The use of CPAP has been associated with a lower incidence of chronic lung disease when used as the initial respiratory support. Also, mechanical ventilation has the potential to injure the airways and lung parenchyma [2].

Recently, there has been a renewed interest in gentle ventilation strategies, such as CPAP as a way to improve outcomes for very preterm infants. A wide variety of devices are used to deliver CPAP, including single or binasal prongs where pressure is generated by a column of water (bubble CPAP) or a ventilator. Bubble CPAP (BCPAP) is appealing because of its simplicity and low cost [2].

Patients and Methods

This study aimed to evaluate how much the adopted protocols of using CPAP are applied in neonatal Intensive Care Unit in Assiut University Children Hospital from 1 st of June 2015 to 30th of January 2017. The adopted protocols used followed the American association respiratory care guidelines 2004 and Queensland clinical guidelines 2014 which is locally approved by the Neonatal Intensive Care Unit in Assiut University Children Hospital. Data collection was done by reviewing the sheets and direct observation of patients receiving CPAP care in NICU of AUCH during the study duration. The study included 60 neonates with respiratory distress receiving BCPAP care. Their ages ranged from 27wks to 40wks gestational age and post natal age from 1 to 25 days old (27 cases were males and 33 were females).

Inclusion criteria:

Neonates less than or equal 28 days old receiving CPAP care due to various causes of respiratory distress.

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Exclusion criteria:

Neonates more than or equal 28 days old.

Neonates with respiratory distress receiving other methods of respiratory support rather than CPAP.

An observational checklist based on the American association respiratory care guidelines 2004 and Queensland clinical guidelines 2014 was developed by investigators in order to asses adherence of medical staff to the guidelines and adapted protocols of using NCPAP.

Parameters assessed:

- Complete history taking which included gestational age (wks), mode of delivery, occurrence of obstructed labor, history of fetal hypoxia, administration of surfactant, history of O_2 administration, mode of O_2 administration & percentage of O_2 used, performance of abdominal or chest surgery and weaning from mechanical ventilation.
- Complete examination which included gestational age, weight, vital signs (temp., pulse, respiratory rate, blood pressure), umbilical stump & nails condition, abdominal, cardiac and chest examination.
- Investigations which included blood gases analysis, ECG monitoring, chest X-ray, pulse oximeter measurements.
- Indications of connection according to resident doctors (provisional diagnosis).
- Evaluation of CPAP device which included blended air/oxygen supply, flow meter at 5-10 l/m, humidifier water level, whether excess rainout in the afferent tubing was drained, nasal prong size, nasal prongs position or nasal mask, hat fits, corrugated tubing placement, whether head position was correct, tape at 7cm at base of bottle, gas bubbling.
- Monitoring of the baby on nasal CPAP the following systems were checked every 2-4 hours which included respiratory (respiratory rate, grunting, nasal flaring, breath sounds), temperature, cardiovascular (blood pressure, auscultation) neurological (tone, activity), gastro-intestinal (free passage of stool, abdominal distension, intestinal sounds.
- Follow-up investigations which included blood gases analysis, ECG monitoring, chest X-ray, pulse oximeter measurements.
- Weaning of CPAP according to Queensland clinical guidelines 2014.
- Outcome of CPAP used.

Results

Table (1): Recorded demographic data.

	No.	%
Gender:		
Male	27	45.0
Female	33	55.0
Gestational age:		
Range	27-40wks	
Preterm (less than 37 weeks)	52	86.7
Full term (more than or equal 37 weeks)	8	13.3

Table (2): Recorded data about history of the cases.

	Recorded		Not recorded	
	No.	%	No.	%
Gestational age:	60	100.0	0	0.0
Range	27-40wks gestational age			
Mean ± SD	33.73 ±4.29			
Mode of delivery:	60	100.0	0	0.0
NVD	29	48.3		
CS	31	51.7		
Obstructed labor:	59	98.3	1	1.7
Yes	7	11.7		
No	52	86.7		
History of fetal hypoxia:	59	98.3	1	1.7
Yes	8	13.3		
No	51	85.0		
History of administration of surfactant:	60	100.0	0	0.0
Yes	12	20.0		
No	48	80.0		
History of O2 administration:	60	100.0	0	0.0
Yes	60	100.0		
No	0	0.0		
Mode of O2 administration & percentage of O2 used:	59	98.3	1	1.7
Yes	55	91.7		
No	4	6.7		
History of abdominal or chest surgery:	60	100.0	0	0.0
Yes	0	0.0		
No	60	100.0		
History of weaning from mechanical ventilation:	60	100	0	0.0
Yes	13	21.7		
No	47	78.3		

Table (3): Recorded data about examination in studied cases.

Examination	Recorded		Not recorded	
	No.	%	No.	%
Gestational age:	60	100.0	0	0.0
• Range (wks)	27-40			
• Mean ± SD	33.73±4.28			
Weight (grams):	60	100.0	0	0.0
• Mean ± SD	1523.29±849.11			
Temp (rectal or core) (c):	60	100.0	0	0.0
• Normal (36.5-37.5)	57	95.0		
• High (> 37.5)	1	1.7		
• Low (<36.5)	2	3.3		
Pulse (resting) (b/m):	60	100.0	0	0.0
• Normal (120-160)	44	73.3		
• High (>170)	15	25.0		
• Low (<100)	1	1.7		
Respiratory rate (c/m):	60	100.0	0	0.0
• High (>60)	59	98.3		
• Low (<40)	1	1.7		
Blood pressure (according to age & our NICU protocol):	60	100.0	0	0.0
• Normal	51	85.0		
• Low	9	15.0		
Umbilical stumb & nails:	60	100.0	0	0.0
• Normal	54	90.0		
• Abnormal (meconium stained)	6	10.0		
Abdominal exam:	59	98.3	1	1.7
• Normal	59	98.3		
Cardiac exam:	60	100.0	0	0.0
• Normal	58	96.7		
• Abnormal	2	3.3		
Chest examination:	60	100.0	0	0.0
Retraction:	60	100.0		
• Yes	60	100.0		
Significant apnea:	59	98.3	1	1.7
• Yes	18	30.0		
• No	41	68.3		
Grunting:	60	100.0	0	0.0
• Yes	41	68.3		
• No	19	31.7		
Adventious sounds:	60	100.0	0	0.0
• Yes	6	10.0		
• No	54	90.0		

Table (4): Recorded data about investigations (pre connection).

	Recorded		Not recorded		Done		Not done	
	No.	%	No.	%	No.	%	No.	%
• Blood gases	32	53.3	28	45.7	32	53.3	28	45.7
• Chest X-ray	0	0.0	60	100.0	58	96.7	2	3.3
• Pulse oximeter	0	0.0	60	100.0	60	100.0	0	0.0
• Continuous ECG	0	0.0	60	100.0	0	0.0	60	100.0
• Indications of connection according to resident doctors	60	100	0	0	60	100	0	0

Table (5): Monitoring of CPAP device during use.

	Recorded		Not recorded		Done		Not done	
	No.	%	No.	%	No.	%	No.	%
• Blended air/oxygen supply is appropriate.	0	0.0	60	100.0	60	100.0	0	0.0
• Flow meter at 5-10l/m.	0	0.0	60	100.0	60	100.0	0	0.0
• Check humidifier water level is correct.	0	0.0	60	100.0	60	100.0	0	0.0
• Nasal prongs positioned correctly & not touching the septum or nasal mask.	0	0.0	60	100.0	60	100.0	0	0.0
• Check head position is correct.	0	0.0	60	100.0	60	100.0	0	0.0
• Corrugated tubing correctly placed.	0	0.0	60	100.0	60	100.0	0	0.0
• Gas bubbling continuously.	0	0.0	60	100.0	60	100.0	0	0.0

Table (6): Recorded data about investigations for follow-up.

	Recorded		Not recorded		Done		Not done	
	No.	%	No.	%	No.	%	No.	%
Blood gases	32	53.3	28	45.7	32	53.3	28	45.7
Chest X-ray	0	0.0	60	100.0	58	96.7	2	3.3
Pulse oximeter	0	0.0	60	100.0	60	100.0	0	0.0
Continuous ECG	0	0.0	60	100.0	0	0.0	60	100.0

Table (7): Weaning from CPAP.

	Recorded		Not recorded	
	No.	%	No.	%
Weaning	60	100	0	0.0
Gradually & successful	35	58.3	0	0.0
Failed	25	41.7	0	0.0

Table (8): Outcome.

	Recorded		Not recorded	
	No.	%	No.	%
Improved	35	58.3	0	0.0
Failed:	25	41.7	0	0.0
1- Central apnea (significant)	12	48.0		
2- Haemorragic disease	2	8.0		
3- Sepsis	6	24.0		
4- Congenital anomalies	5	20.0		

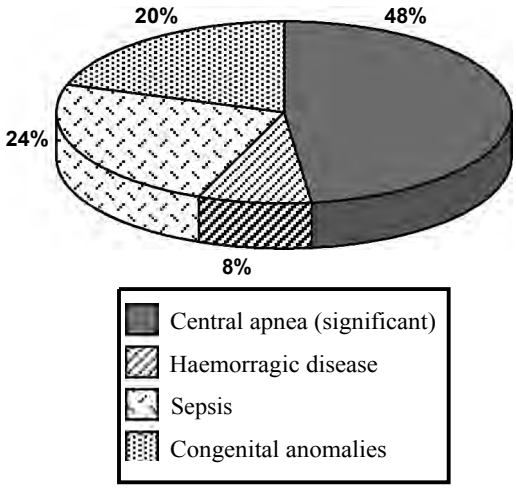

Fig. (1): Causes of CPAP failure.

Discussion

Our study included 60 neonates receiving BCPAP care as it is the only available type of CPAP in our NICU. Our study is supported by Tagare et al., 2013 [3] study that was comparing the use of Bubble CPAP and ventilator CPAP (conventional CPAP). Their results showed that Bubble CPAP has higher success rate than ventilator CPAP (82.5% vs. 63.2%).

In our study only 12 cases (20%) were given surfactant before CPAP use. However CPAP and surfactant work together towards establishing and maintaining functional residual capacity in RDS. Kandraju et al., 2013 [4] stated that the need for mechanical ventilation was significantly less in early rescue surfactant group (16.2% vs. 31.6%).

In our study weaning from CPAP was gradual and successful in 58.3% of cases by using the guidelines. In our NICU newborns were kept on NCPAP until they were on FiO_2=0.21 and pressure of 5cmH_2O and then were weaned off NCPAP completely. Failure occurred in 41.7% of cases and this failure of weaning was due to failure in CPAP system in those cases which results in sudden disconnection of CPAP to connect the patient to mechanical ventilation or death. Other studies supporting our technique of weaning such as Todd et al., 2012 [5] study stated that weaning should be done when neonates were clinically stable on CPAP 4-6cm with FiO_2 <25% for at least 12 hours and that method one (Taken 'OFF' CPAP with the view to stay 'OFF' completely) significantly shortened CPAP weaning time, CPAP duration, oxygen duration, BPD and length of admission.

In our study the outcome of BCPAP showed improvement in 58.3% of cases, failure here means worsening of medical conditions of the cases that ended by connection to mechanical ventilation or death. Causes of failure were; frequent central apnea in 12 (48%) cases, hemorrhagic disease of the newborn in 2 (8%) cases, severe sepsis in 6 (24%) cases and congenital anomalies (mainly cardiac) in 5 (20%) cases. Our results were in agreement with that represented by Maiya et al., 2009 [6] who stated that failure was in 20% they related that to severe RDS (down score 7 at admission), gestational age (28wks or less), low birth weight especially from 750gm to 1250gm, antenatal steroids (no exposure or partial exposure increase risk).

Conclusion:

Data of the study showed that using NCPAP for cases of respiratory distress in neonatal Intensive Care Unit in Assiut University Children Hospital partially follow the reference standard guidelines of the study.

Recommendations:

- Following the guidelines about indications, contraindications and investigations of the use of CPAP as it is partially followed by resident doctors in NICU in AUCH.
- Regular refreshment of resident doctors information about guidelines for using of CPAP as many of them don't know other indications of CPAP rather than RDS.
- Don't use CPAP when it is not indicated as it will fail.
- Recording all data in patient sheet as there is big defect in recording data especially data of CPAP set up and monitoring in the Neonatal Intensive Care Unit in Assiut University Children Hospital.
- Considering addition of master sheet containing data about CPAP set up and monitoring to patient sheet to insure recording of all these data and not to be missed.
- Clinical monitoring and regular check of CPAP system during use must be done every 2-4 hours as recommended by guidelines to insure good results and early detection of complications.
- Investigations should be done when needed with no over use of investigations as doing blood gases several times without obvious causes and also doing X-ray for almost all patients without obvious cause.
- Do not use mechanical ventilation while cases can benefit from use of CPAP unless it is indicated.

- Periodic examination of nasal septum to detect early any necrosis of the septum.
- Insure availability of variable sized nasal prongs that can fit any neonate to minimize the risk of nasal trauma.

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Limitations of study:

- Deficiency of recording data in patient sheet.
- Small numbers of newborns receiving CPAP care.

No conflicts of interest.

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دراسة تدقيقية إكلينيكية على إستخدام الضغط الإيجابى المتواصل على المجرى الهوائى بوحدة رعاية الأطفال حديثى الولادة بمستشفى الأطفال الجامعى بأسيوط

الضغط الإيجابى المتواصل على المجرى الهوائى هو إستخدام ضغط إيجابى على الممرات الهوائية لطفل يتنفس تلقائيا خلال دورته التنفسية الطبيعية ويعد إستخدامه من الطرق الجذابة لتدعيم التنفس لمريض يعانى من ضيق التنفس حيث أنه يحفظ التنفس التلقائى وأيضا يعد إستخدامه أقل ضررا على الجهاز التنفسى حيث أن نسبة حدوث أمراض رئوية مزمنة نتيجة لإستخدامه أقل مما يحدث نتيجة لإستخدام أجهزة التنفس الصناعى.

أهداف البحث: تقييم إلى أى حد يتم تطبيق النظم المتبعة فى إستخدام الضغط الإيجابى المتواصل على المجرى الهوائى بوحدة رعاية الأطفال حديثى الولادة بمستشفى الأطفال الجامعى بأسيوط خلال الفترة من أول يونيو ٢٠١٥ إلى ٣٠ يناير ٢٠١٧.

الفئات المستهدفة: كل الأطفال الذين تلقوا رعاية بوحدة الأطفال حديثى الولادة بمستشفى الأطفال الجامعى بأسيوط بإستخدام الضغط الإيجابى المتواصل على المجرى الهوائى فى الفترة من ١/٦/٢٠١٥ إلى ٣٠/١/٢٠١٧ والذين لا تزيد أعمارهم عن ٢٨ يوم.

الفئات المستبعدة: كل الأطفال الذين تلقوا رعاية بوحدة رعاية الأطفال حديثى الولادة بمستشفى الأطفال الجامعى بأسيوط بإستخدام وسائل أخرى لتدعيم التنفس غير إستخدام الضغط الإيجابى المتواصل على المجرى الهوائى. الأطفال الذين تزيد أعمارهم عن ٢٨ يوم.

النتائج: يتضمن البحث ٦٠ حالة تلقوا رعاية بوحدة رعاية الأطفال حديثى الولادة بإستخدام الضغط الإيجابى المتواصل على المجرى الهوائى أعمارهم أقل من ٢٨ يوم، وأظهرت بيانات الدراسة أن النظم المتبعة فى إستخدام الضغط الإيجابى المتواصل على المجرى الهوائى أتبعت جزئيا المعايير المرجعية للدراسة.