

Original Article

Oxygen therapy in neonatal intensive care units in Khartoum State

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ABSTRACT

Oxygen is a drug that is essential in the treatment and prevention of neonatal hypoxia. The goal of oxygen therapy is to deliver sufficient oxygen to tissues while minimizing oxygen toxicity and oxidative stress. Improvement in monitoring technology of oxygen therapy has helped to improve clinicians' ability to appropriately apply and deliver oxygen. The objectives of this prospective observational descriptive hospital based study were: to evaluate the practice of oxygen therapy in the neonatal intensive care units (NICUs) in Khartoum State, to identify guidelines of oxygen therapy in NICUs, to determine the mode of oxygen delivery to the neonates, and to assess the practice of long term follow up of patients who used oxygen. During the period January - June 2014, 139 neonates were included. Oxygen was delivered to the neonates in the study depending on the clinical assessment. Saturation was not measured at the time of oxygen administration in 119 (85.6%)

neonates. Oxygen was delivered by central device in 135 neonates (97.1%). The majority of the staff did not know the practice of long-term follow up. Hundred and sixteen (83.5%) of the nursing staff knew that oxygen has complications but the majority didn't know the nature of the complications and what causes them. The study showed that there is lack of guidelines of oxygen therapy in the NICUs and lack of monitoring procedures, which is important to be highlighted to overcome the complications and to improve the practice of oxygen therapy.

Keywords:

Oxygen; Guidelines; Neonate; Preterm; Khartoum; Sudan.

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INTRODUCTION

The overall goal of oxygen therapy is to achieve adequate oxygenation using the lowest concentration of inspired oxygen. However, achieving this goal is complicated by a number of factors [1]. Despite over 75 years of routine oxygen administration to newborn infants, the optimal level of oxygenation—one that avoids the detrimental effects of hypoxia on hand, and those caused by hyperoxia on the other—has not yet been clearly defined, leading to wide variations in practice [2-5]. Even the term “adequate oxygenation” is not clear [6]. Other complicating factors in achieving the goals of neonatal oxygen therapy include patient size, tolerance of delivery device, and variability in the use of delivery devices, which suggest that clinicians lack adequate knowledge in the use of oxygen delivery equipment, and the lack of training in the practical aspects of neonatal oxygenation and equipment used to monitor the effects of oxygen therapy [7,8]. Oxygen is a drug, so it should be prescribed by medical personnel who determine the device and length of time that it is to be administered. If the need for supplemental oxygen persists after resuscitation, the gas should be warmed, humidified, and delivered using a system in which the concentration can be regulated [9].

MATERIALS AND METHODS

Study Design:

Prospective observational descriptive hospital based study.

Study area:

The study was conducted in Khartoum State in the neonatal intensive care units (NICUs) of the main public hospitals. These are: Soba University Hospital, Gaffer Ibauf Children’s Hospital and Omdurman Maternity Hospital.

Study Period:

The study was conducted between the 1st of January

2014 and the 30th of June 2014.

Study population:

All neonates who were admitted to the neonatal care units during the study period and who were given oxygen therapy.

Exclusion Criteria:

Neonates who had congenital heart or lung diseases.

Sample size:

Sample size was calculated using this formula:

$$N = \frac{p^2(1-p) z_{1-\alpha/2}^2}{W^2}$$

p is the expected proportion that has the characteristic of interest.

W is the margin of error

$z_{1-\alpha/2}$ is a value from the normal distribution related to and representing the confidence level.

N is the population size

For P = 0.5

w = .14

$\alpha = .1$

n = 139

The sample size was calculated after a pilot study was done in the first month of the study period, and twenty neonates were involved. Written approval was obtained from the hospitals administration and the heads of the neonatal units.

RESULTS

One hundred thirty nine neonates admitted to Soba University Hospital, Omdurman Maternity Hospital, and Gaafar Ibauf Childrens’ Hospital, who received oxygen during the period January 2014 -June 2014, were studied. Eighty-four (60.43%) of them were males and 55 (39.57%) were females. Seventy-one (51.1%) were preterm and 68 (48.9%) were term. Seventy-eight (56.1%) weighing 2.5 - 3.5kg, 55 neonates (39.6 %) weighing 3.5-4kg, 3 neonates (2.2%) were between 1 -1.5kg and 3 (2.2%) weighed more than 4kg.

Indications for admission among preterms were:

respiratory distress syndrome (RDS) in 57 (41.0%) neonates, RDS and miscellaneous cause of admission in 10 (7.2%), apnoea in 3 (2.2%) and miscellaneous cause of admission in 1 (0.7%) of the studied neonates (Table 1).

Table 1 - Indications for oxygen therapy in the study group

	Frequency	Percentage
Clinically distressed	125	89.9
Apnea	9	6.5
Clinically distressed and low oxygen saturation	3	2.2
Others	2	1.4
Total	139	100

Indications for admission in the 40 (28.8%) term studied neonates were RDS in 20 (14.4%), birth asphyxia 3 (2.2%), transient tachypnea of the newborn (TTN) and infants of diabetic mothers (IDM) 2 (1.4%), and sepsis 1 (0.7%). Oxygen saturation was not done for 119 (85.6%) neonates at the start of administration of oxygen and it was < 85% in one (0.7%) of the studied neonates. It was between 90 and 92 in 4 (2.9%) and >92 to < 95 in 5 (3.6%) (Table2).

Table 2 - Oxygen saturation at the start of administration of oxygen therapy

	Frequency	Percentage
< 85	1.00	0.7
90 - 92	4.2	3.0
> 92 - < 95	5.3	3.5
> 95	10	7.2
Not done	119	85.6
Total	139	100

The amount of oxygen prescribed for 132 neonates (95%) was 1-1.5 litre, 2 litres was prescribed for 6 (4.3%) and 6 litres for 1 (0.7%), and this amount was given throughout the period of oxygen administration (Table 3).

Table 3 - The prescribed oxygen in liters

	Frequency	Percentage
1-1.5 liters	132	95
6 liters	1	0.70
2 liters	6	4.30
Total	139	100

Out of the studied neonates 63 (44.6%) were put on oxygen for 1 to < 3 days, 39 (28.78%) neonates were put for 3 to < 7 days, 34 (24.5%) neonate were put for hours and those who were put for more than 2 weeks were 3 (2.2%). The mode of oxygen delivery to the neonates was central in 135 (97.1) and by cylinder in 4 (2.9%). The most commonly used device for oxygen delivery was nasal cannula and it was used for 138

(99.3%) neonates in the study and via incubator for only 1 neonate (0.7%). The justification of the nurses for the use of the nasal cannula, was that it was the only available device for 110 neonates (80.1%), and it was used for 25 neonates (18.0%) because it was believed to give the needed amount of oxygen, and the nurse didn't know why the prescriber chose this device in 4 (2.9%) neonates (Table 4).

Table 4 - Justification of the nursing staff for the selected devices used to deliver oxygen

Justification	Frequency	Percentage
It is the only available device in the neonatal unit	110	79.1
It gives the needed amount of oxygen	25	18.0
Do not know why it was chosen	4	2.9
Total	139	100

Regarding knowledge of the staff about the complications of oxygen therapy, 116 (83.5%) of them knew that oxygen has complications and 23 (16.5%) didn't. Despite the fact that the majority of them knew that oxygen has complications, they were not aware about the causes and types of the complications. Thirty four (24.5%) of the staff attributed the complications

to high saturation, while 4 (2.9%) to low saturation only, duration of oxygen therapy in 6 (4.3 %), due to both concentration and duration in 4 (33.1%), high saturation and duration in 6 (4.3%) and 43 of the staff (30.9%) knew oxygen has complications but were not aware about them (Table 5).

Table 5 - Staff knowledge about the expected causes of complications of oxygen therapy

	Frequency	Percentage
Concentration and duration of oxygen therapy	46	33.1
High saturation	34	24.5
Low saturation	4	2.9
Duration of oxygen therapy	6	4.3
High saturation and duration of oxygen therapy	6	4.3
Do not know	43	30.9
Total	139	100

DISCUSSION

The total number of the studied neonates was 139. Term and preterm babies were included in the study. The majority of the preterms were 32-36 weeks of gestation. The main cause of admission in term babies was RDS and asphyxia, while in preterms it was mainly RDS. The main indication for the start of oxygen therapy was the clinical condition only and this was attributed to deficiency of the monitoring devices like pulse oximeters, and this was the practice before 1960s and 1970s [1]. In the majority of the studied neonates oxygen saturation was not done on admission and at time of prescribing oxygen. Most of NICUs current monitoring strategies employ targeting the peripheral capillary oxygen saturation values (SpO₂) rather than targeting the partial pressure of arterial oxygen (PaO₂) levels to prevent hypoxemia and hyperoxia, which is associated with neonatal complications especially in preterm neonates and in general SpO₂ values from 85% to 95% provide SpO₂ range that avoid hyperoxia. As illustrated in a study of 98 consecutive infants of less than 29 weeks gestation, the mean PaO₂ at 85% SpO₂ was 40 mmHg (range of 29-51 mmHg) and at 95% SpO₂ the mean PaO₂ was 50 mmHg (Range 41 to 67mmHg)[10]. In the present study, the majority of the neonates received 1 to 1.5 litre and that is good because high concentration of oxygen is associated with retinopathy of prematurity (ROP) and bronchopulmonary dysplasia (BPD) [1].

There are several ways to deliver oxygen to a baby. The selection of a method depends on how much oxygen is needed and whether the baby needs a breathing machine. In the current study oxygen was delivered through nasal cannula in almost all of the studied neonates and this was mainly due to its availability; although it got some complications but it is generally easy to apply. The majority of the neonates received oxygen for 1 to 3 days and oxygen was delivered to most of the neonates through central devices [11]. Most of the involved staff did not know the practice of long term follow up. Although the majority knew that oxygen has its complications, yet most of them had wrong information about the causes and types of the complications [12].

CONCLUSION

This is the first study to evaluate the practice of oxygen therapy in NICUs in Sudan. The study revealed lack of guidelines for oxygen therapy, and deficiency or lack of monitoring devices like pulse oximeters, which are very crucial for the management of neonates. Oxygen was usually delivered by nasal cannula, as it was the only available device. There was lack of knowledge or wrong information of the staff regarding the complications of oxygen therapy, associated with deficient knowledge about the practice of long term follow up and its importance to the patients who received oxygen. Further studies are recommended.

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