Monitoring of oxygen therapy in neonatal care units in Khartoum State

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Abstract

Background: 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 study were to evaluate the practice of oxygen monitoring and weaning in the neonatal care units in Khartoum State.

Materials and Methods:

This is a prospective, observational and descriptive hospital-based study conducted during the period January - June 2014. One hundred and thirty nine neonates were included in the study. Data was collected using a structured questionnaire. The questionnaire contained questions about personnel data, the practice of delivering oxygen, practice of monitoring, weaning and the knowledge of the staff about complications of oxygen therapy.

Results:

One hundred and thirty nine newborns were enrolled in the study. Males were 84 (60.4%)and females were 55 (39.6%) .Saturation was not measured at the time of oxygen administration in 119 (85.6%) neonates . Monitoring was interrupted in 136 neonates (97.8%) and done by pulse oximetry and clinically in 134(96.4%) . Humidification was checked in 135 (97.1%) of neonates .

Oxygen was monitored for all neonates in the study . monitoring was done by pulse oximetry and clinically in 134 neonates (96.4%) , pulse oximetry and ABG in 4 neonates (2.9%) and pulse oximetry and arterial blood gas (ABG) and clinically in 1 (0.7%).

Conclusion:

The study showed there was shortage of monitoring devices. This should be highlighted to overcome the complications and to improve the practice of oxygen therapy.

Distribution of guidelines regarding oxygen therapy as well as improvement of oxygen delivery devices and monitoring systems are recommended.

Introduction:

Oxygen supplementation is an important component of intensive care of the newborn. Careful monitoring is required to minimize pulmonary toxicity or the consequences of hypoxemia or hyperoxia. The two main complications of excessive oxygen are lung injury and retinopathy of prematurity. They

are caused by different factors, e.g. lung injury associated with high inspired oxygen concentration, and retinopathy associated with high arterial oxygen tension and extreme immaturity. On the other hand, there are concerns that excessively low oxygen saturation may be associated with increased mortality or risk of neurodevelopmental impairment.

The overall goal of oxygen therapy is to achieve adequate oxygenation using the lowest concentration of inspired oxygen [1-3].

The use of 100% oxygen during neonatal resuscitation has also been challenged, on the premise that large and abrupt increases in blood oxygen level after birth can increase oxidative stress [4].

Several studies have compared the use of air (21 %) to 100% oxygen during resuscitation. Supplemental oxygen is the commonest drug prescribed in hospitals[5]. Supplemental oxygen is provided to correct or prevent hypoxemia and hypoxia which can occur as a result of cardiovascular, metabolic, neurological or respiratory dysfunction[6].

Oxygen is a drug so it should be prescribed by a medical personnel who determines 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.

One of the complications of oxygen therapy, even for relatively short periods of time, is the drying of the upper airway, which causes secretions to be thicker and harder to expectorate. Humidification minimizes this mucosal drying and retention of secretions.

Non-invasive methods of measuring blood oxygen levels in neonates have been developed in recent years. Transcutaneous measurement of the partial pressure of oxygen (TcPO2), a technology developed in the 1970s, appears to approximate actual arterial oxygen levels well in most circumstances.

Oxygen saturation monitoring using pulse oximetry has gained widespread use in neonatal nurseries since the early 1980s due to its ease of use and lack of heat-related adverse effects, particularly in extremely preterm infants who have sensitive skin.

Pulse oximetry measures hemoglobin saturation(SpO2) and reflects the 98 percent of arterial oxygen content that is carried normally by hemoglobin[7]. This monitoring technique provides data that are immediate, continuous, and non-invasive, and, therefore, avoids some limitations of intermittent arterial blood sampling. As a result, in most neonatal intensive care units, pulse oximetry is the accepted standard for routine monitoring, and SpO2 has been called the “fifth vital sign” [8].

Oxygen monitoring of the newborns is limited in Khartoum state to few hospitals due to lack of enough devices. This study aims at evaluating the practice of oxygen monitoring and weaning in the neonatal care units in Khartoum State

Materials and Method

This was an observational descriptive hospital-based study. The study was conducted in Khartoum State in the neonatal care units of the main public hospitals. These are: Soba University Hospital, Gaffer Ibn-auf Children´s Hospital and Omdurman Maternity Hospital.

Soba University Hospital (SUH): is located 15 km south of the center of the capital of Sudan, Khartoum. The neonatal intensive care unit (NICU) in the hospital receives about 700-800 newborns yearly. The obstetric department in SUH is one of the main referral centers for high risk pregnancies in Sudan and receives cases from the whole country including both governmental and nongovernmental sectors. There are five cardiorespiratory monitors and three pulse oximeters.

Omdurman Maternity Hospital was the first specialized hospital in the country to provide care and medical services to mothers and newborn babies, it is located in Khartoum State, Omdurman Province. Its services cover all the surrounding area, rural areas and even nearby towns. The NICU

department accommodates about 60 babies per day. There are ten cardiorespiratory monitors and three pulse oximeters.

Gaffer Ibn-auf Hospital is located in the center of Khartoum. It has no delivery suite but the NICU receives referred newborns according to its capacity which is around 20 babies per day. There are four cardiorespiratory monitors and two pulse oximeters.

There is no clear written guidelines regarding oxygen therapy in the studied NICUs.

All neonates who were admitted to the neonatal care units during the study period ,January2014-June 2014 and who were given oxygen therapy were included in the study,

Neonates who had congenital heart or lung diseases were excluded from the study.

Ethical approval:

Ethical approval was obtained from the Sudan Medical Specialization Board, written consent from hospital administration and the treating doctors. Informed verbal consent was obtained from parents or care givers.

Confidentiality was maintained. Data will be only used for the purpose of the study.

Statistical analysis:

Data was analyzed using Statistical Packages for Social Sciences (SPSS).

Results and Discussion:

One hundred thirty nine newborns satisfied the enrollment criteria. Seventy-one (51.1%) of them were preterms and 68(48.9%) were terms.

One hundred and nineteen patients(85.6%) were started on oxygen therapy on clinical grounds without measuring of oxygen saturation.

Oxygen was monitored in all cases. Pulse oxymetry was used in all patients, while arterial blood gas (ABG) was done for 5(3.6%) patients only. However oxygen monitoring with pulse oxymetry was interrupted in 136 neonates (97.8%) in view of lack of enough devices.

Humidification was checked in 135 (97.1) of the cases . The frequency of checking of the water in the humidifier was done once daily in 61(43.9%),

and was not routinely checked till the humidifier was empty in 67 (48.2%) .

Oxygen was stopped abruptly in 86 (61.9%) of the cases and stopped gradually in 53(38.1%) of the cases.

The indications for oxygen weaning is shown in table 1.Most,134(96.4%), of the patients were weaned on clinical grounds ,and in 4 (2,9%) due to the need of oxygen for another ill newborn.

The person who took the decision of oxygen weaning is shown in table2.

In 58(41.7%) the decision was taken by the nurse.

Table1. Indications for oxygen weaning

Indications	Frequency	Percent
Clinical improvement	134	96.4
Clinical improvement and oxygen saturation	1	0.7
Needed for another neonate	4	2.9
Total	139	100.00

Table 2 . The person who decided oxygen weaning

Frequency	Percent
Consultant	74
53.3	
Residents	7
5.0	
Nurse in charge	58
41.7	
Total	139
100.0	

This is the first study to evaluate the practice of oxygen therapy in neonatal care units in Sudan.

In the majority of the studied neonates(97.8%) monitoring was not a continuous process, as it was done every 3 or 6 hrs as planned by routine check of the individual NICU, so the neonates were vulnerable to undetected periods of hypoxia or hyperoxia[1] and this is attributed to shortage of monitors as well as clear guidelines regarding oxygen therapy. Continuous oxygen monitoring can prevent hypoxia and hyperoxia and the associated serious complications and hence reduction in long-term disabilities .

All neonates in the study were followed by the nursing staff as the monitoring is considered as a nursing job. Gradual tapering before weaning was done for 53 neonates (38 .1%) and abrupt weaning was done for 86 (61.9%). Most of NICUs current monitoring strategies employ target pulse oxygen saturation values rather than targeted PaO_2 levels to prevent hypoxemia and hyperoxia which is associated with neonatal complication especially in preterm neonates. In general SpO_2 values from 85% to 95% provide a PO_2 range that avoid hyperoxia as illustrated by study of 98 consecutive infants of less than 29 wks gestation; the mean PaO_2 at 85% SpO_2 was 40 mmHg (range of 29 to 51 mmHg) and at 95% SpO_2 the mean PaO_2 was 50mmgh(rang 41 to 67mmHg) as shown by Quine et al[9]. Oxygen weaning decision of the studied neonates was taken by consultants in 74 neonates (53.3%); the nurse in charge in 58 (41.7); and by the residents in 7 neonates (5.0%). The decision of weaning was taken because of improvement of the clinical condition of the neonates in 134(96.4%); need of oxygen for another ill neonates in 4 (2,9%). The thought of weaning should start the moment the patient is comfortable. There are several clinical and laboratory parameters which need to be continuously assessed. Symptoms and signs of hypoxaemia and tissue hypoxia should be carefully monitored. Weaning should be initiated once the patient's underlying disease process is stabilized and bedside evaluation of respiratory rate, heart rate, blood pressure, skin colour and pulse oximetry are normal.Weaning can be gradually attempted by either discontinuing oxygen altogether or lowering its concentration for a fixed period and re-evaluating the clinical parameters and SpO2. An initial attempt of withdrawal for about 30 minutes is followed by longer periods. If there is no deterioration, oxygen may be completely withdrawn[10].

The humidification was checked in the majority(97.1%) of the studied neonates but that was done when the humidifier was empty in the majority and as Feel et al reported humidification minimizes inflammation and mucosal injury and retention of secretion[6]. Low flow oxygen rates (less than 4 L/min) do not require humidifcation as the humidity of gas at this level is adequate. However if the nasal passages do become dry and excoriated, humidity is required.

Gas flow greater than 4L/min should have humidification applied if the oxygen is required for longer than 48 hours or if the nasal passages are becoming uncomfortable or dry.

If there is not enough humidity in the inspired gas, not only do the nasal passages become dry and painful but also there is a higher risk for development of atelectasis, lung collapse or infection[6].

Conclusion:

The study revealed lack of guidelines for oxygen therapy and shortage of monitoring devices like pulse oximeters .

Recommendation:

Monitoring devices should be available in all NICU as well as continuous oxygen monitoring .

Guidelines regarding oxygen therapy should be distributed in all neonatal care units.

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