J Obstet Gynecol India Vol. 57, No. 6 : November/December 2007 Pg 493-497

ORIGINAL ARTICLE

The Journal of Obstetrics and Gynecology of India

Oxygen inhalation in the immediate postpartum period reduces vaginal blood loss

Asanga B **Yatawatta** [1], *Jeevani K* **Ubhayawansa** [1], *Dammi P* **Sugathadasa** [1], *Indragee W* **Amarasinghe**[2], *Ranjith PV* **Kumarasiri** [3], *Chulanananda DA* **Goonasekera** [1]

[1] Departments of Anesthesiology, [2] Obstetrics and Gynaecology, and [3] Community Medicine, Faculty of Medicine, University of Peradeniya, Sri Lanka

OBJECTIVE(S) : To study the effect of oxygen inhalation immediately after normal delivery on blood loss.

METHOD(S) : Sixty consenting women delivering normally vaginally in our tertiary care teaching hospital were alternatively allocated to either receive 40% oxygen via a facemask for 6 hours after the third stage of labor (study group) or breathe room air (control group) in addition to conventional management. Twenty one women in the oxygen inhalation group and 19 in the room air inhalation group had episiotomy. all women were evaluated hourly for vaginal blood loss.

RESULTS : The study and the control groups were similar in age, parity, body weight and induction rate. Mean vaginal blood loss during the 1st hour was 32.4±34.1mL in controls and 16.9±19.1mL in study group receiving oxygen (P=0.05). The mean hourly vaginal blood loss gradually declined in both the groups and was 12.0±8.4mL in the controls and 7.2±3.8mL in the study group (P=0.01) during the 6th hour.

CONCLUSION(S) : Oxygen inhalation immediately after third stage of labor appears to reduce blood loss after normal vaginal delivery.

Key words: postpartum hemorrhage, oxygen inhalation

Introduction

Postpartum hemorrhage (PPH), defined as any bleeding that results in signs and symptoms of hemodynamic instability [1], is a potentially life threatening complication reported to occur in 2-10% of deliveries [2-4]. Hemorrhage occurring within the first 24 hours is termed primary whereas that occuring up-to 6 weeks thereafter is defined as late or secondary. Recent estimates indicate that at least one quarter of all maternal deaths are due to hemorrhage i.e. at least 18,000 annually worldwide [5]. Most of these deaths occur within 4 hours of delivery [6] and are a result of problems during the third stage of labor. PPH also imparts significant morbidity to the reproductive health due to surgical interventions that may result in permanent sterility and due to exposure to blood products [7]. This condition warrants aggressive treatment by an experienced clinician for a favorable outcome. Studies have shown uterine atony as the commonest cause of immediate severe PPH [8].

In the etiology of postpartum uterine atony, hypoxia is considered an important factor although some suggest that peripheral oxygen saturation is not influenced by oxygen inhalation in women during the first and second stages of labor [9] and oxygen inhalation does not improve neonatal outcome [10]. Oxygen desaturation, however, may occur in laboring women with the use of narcotic analgesics [11]. Enhancing oxygen delivery to myometrium through additional inhaled oxygen may improve uterine contractions. Therefore, it is reasonable to consider that oxygen inhalation may promote myometrial contraction and prevent PPH due to uterine atony. The tendency for the uteri to relax in women encountering

Paper received on 20/03/2007 ; accepted on 18/06/2007

Correspondence :
Dr. Chulanananda DA Goonasekera
Department of Anaesthesiology
Faculty of Medicine, University of Peradeniya, Sri Lanka,
Fax : + 94 81 2389106
Email : egoonase@slt.lk

respiratory problems immediately after cesarean section under general anesthesia (personal observation) further strengthened this theory. In this study, we hypothesized that inhaled oxygen helps maintain uterine retraction during immediate postpartum period and hence reduces vaginal blood loss.

Methods

A prospective randomized controlled study was conducted over a period of 4 months at the obstetric unit of our teaching hospital.

The trial was conducted during normal working days (excluding weekends and public holidays). Women with an uneventful singleton pregnancy and good antenatal records admitted to the labor ward in the first stage of labor during the morning of the day of study were included in the study after their informed consent. Women with medical or obstetric condition that may affect postpartum blood loss (e.g. coagulatory disorders, pregnancy induced hypertension, multiple pregnancy, heart disease, and anticoagulant therapy) were excluded. Those who consented in early labor but required an instrumental delivery or cesarean section or had significant perineal trauma or retained products of conception were excluded. Those who did not adhere to the protocol when the study was in progress were also excluded. After delivery the women included in the study were alternatively allotted to study group and control group. Twenty one women in the study group and 19 in the control group had episiotomy. Those in the study group received 7L/minute O_2 via face mask and a portable O_2 cylinder for 6 hours while controls breathed room air. The observations started after delivery of placenta and suturing of episiotomy. All received conventional management which included either oxytocin or ergometrine at delivery of the anterior shoulder, bed rest with close observation in the postnatal ward with their babies at a cot near bedside. Only 2 or 3 mothers were recruited daily as this was the number who could be closely observed for 6 hours after third stage of labor and suturing of episiotomy as per the study protocol (i.e. after delivery of baby and placenta) by a single observer (JKU) with the available resources i.e. oxygen inhalation device, electronic scale and the pulse oximeter.

If a woman dropped out of study for whatever reason after allocating treatment, the next recruit was allocated to receive the same treatment, to ensure equal numbers in each arm of the study. Approval for the study was obtained from the Ethical committee.

Sample size

There was no previous information on the vaginal blood loss following the normal third stage of labor. Hence, there was no guidance to calculate a sample size. We aimed at recruiting approximately 30 in each arm of the study in the first instance. We have 5000 deliveries annually with a 28.9% cesarean section rate. The high rate is attributed to ours being a tertiary referral center.

Data collection

Maternal clinical data including age, body weight, parity, obstetric history, details of present pregnancy, labor, and medications given and the duration of the third stage of labor (i.e. the duration between delivery of baby and delivery of placenta) were recorded in a standard form. During the 6 hour period of observation systolic and diastolic blood pressure (measured by mercury sphygmomanometer), pulse rate and respiratory rate (manual count for one minute) and peripheral oxygen saturation or SpO_2 (measured using pulse oximeter Oxypleth model 520A of Novametrix Medical System Inc.) were recorded at hourly intervals in the supine position. Blood loss was assessed hourly by measuring the net increase in the weight of blood soaked pads using an electronic scale (SUN-3Kg. Accuracy III Division 1, Made in China). Soaked pads were weighed promptly to eliminate weight loss due to evaporation. Vaginal blood loss was assumed to represent the total uterine bleeding.

Statistics

Data were analyzed using SPSS statistical software (Version 7.5). Systolic blood pressure, diastolic blood pressure, pulse rate, SpO_2, respiratory rate and vaginal blood loss were compared between the two groups using independent t tests.

Results

Though initially included in the study, 16 participants had to be excluded later because three needed vacuum extraction and 13 cesarean section. All women received intramuscular uterotonics at third stage of labor. Thirty women were allocated to conventional management breathing room air immediately after third stage of labor. Of the study group six were excluded later because three took off their oxygen masks after five hours, two after four hours and one after 1 hour. They were subsequently replaced by new recruits as mentioned above. The two groups were comparable in age, body weight, parity, induction rate and duration of third stage of labor (Table 1).

Vaginal blood loss during the 1st hour was 32.4±34.1mL in women breathing room air as compared to 16.9±19.1mL in women breathing oxygen by mask (P=0.05). Hourly vaginal blood loss gradually declined in both groups and was 12.0±8.4mL and 7.2±3.8mL respectively (P=0.01) during the 6^{th} hour (Figure 1). Hourly and cumulative vaginal blood

Table 1. Demographic characteristic of the study groups.

Variable	Women breathing room air (Controls) (n=30)	Women receiving 7L/minute oxygen (n=30)	P value
	30	-	
Age in years (mean±SD)	28.03±4.94	29.5±5.76	0.3[a]
Parity			
0	10	13	0.4[b]
1-4	18	16	
≥5	2	1	
Height in cm (mean ± SD)	153.8 ± 6.32	149.2 ± 9.2	0.03 [a]
Weight in kg (mean ± SD)	58.6 ± 10.43	57.1 ± 7.4	0.53[a]
Gestation in weeks (mean ± SD)	39.7 ± 1.03	39.6 ± 1.02	0.76 [a]
Induction of labor	17	14	0.44 [c]
Duration of third stage of labor in minutes (mean ± SD)	4.53±3.22	5.46 ± 3.56	0.3 [a]

[a] t tests, [b] Chi Sq = 0.6345 DF = 1, [c] Chi Sq =0.6007 DF = 1

loss was significantly lower in the study group compared with controls (Figure 1). Significantly higher peripheral oxygen saturation was seen in the oxygen inhaling group throughout the 6 hour study period compared with controls (Figure 2). Pulse rate was 79.1±16.3 per minute and 91.2±16.5 per minute in controls and 71.5±9.8 per minute and 70.1±8.3 per minute in oxygen inhaling group during the 1st and 6th hour (Figure 3). The pulse rates between the two groups were significantly different (P<0.05) with oxygen-inhaled mothers returning lower values (Figure 3). A trend for an increase in the pulse rate was also noted with time in the control group as opposed to oxygen inhaled group who maintained almost a uniform pulse rate (Figure 3). The systolic blood pressure was not significantly different in the two groups throughout the study period (Figure 4). Similarly the diastolic pressure too was not significantly different between the two groups (data not shown). The respiratory rate was also not significantly different between the two groups (Figure 5).

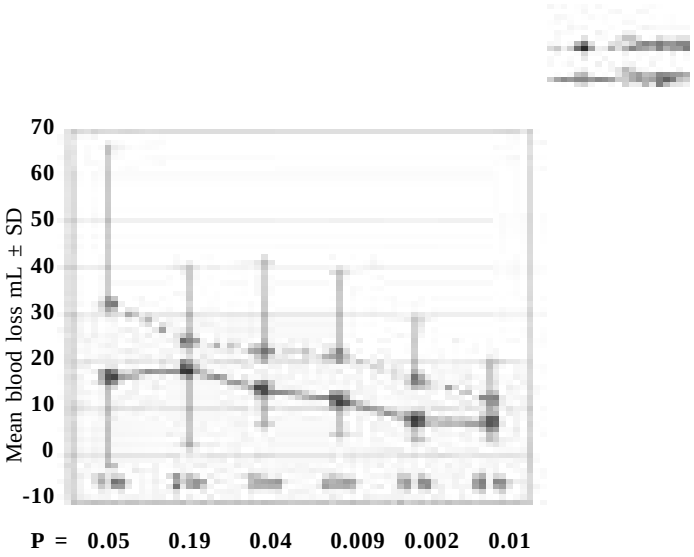

Figure 1. Mean hourly blood loss (mean ± SD) following third stage of labor.

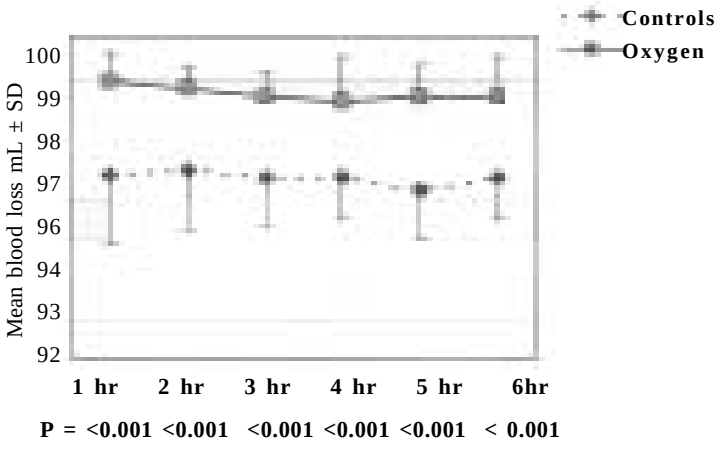

Figure 2. Mean hourly SpO2 (mean ± SD) following third stage of labor.

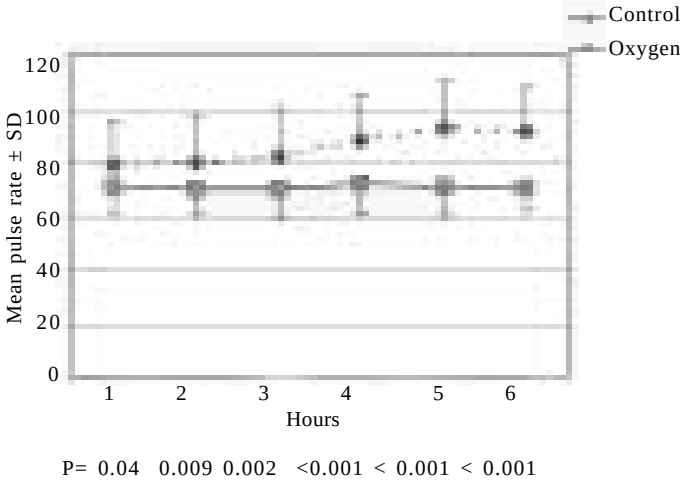

Figure 3. Mean hourly pulse rate (mean ± SD) following third stage of labor.

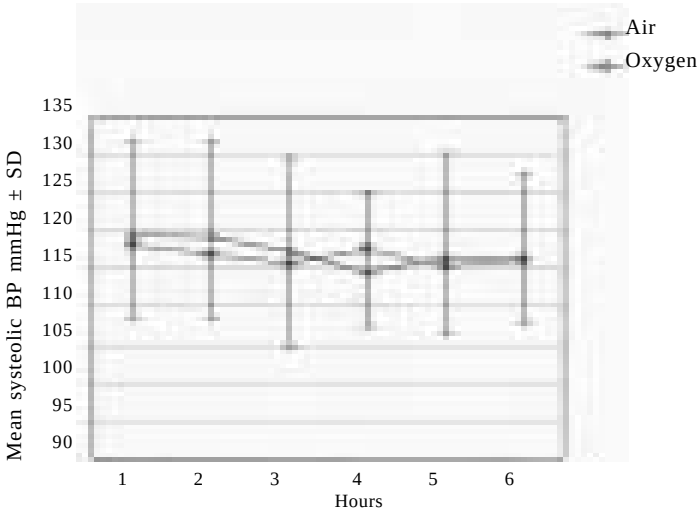

Figure 4. Mean hourly systolic blood pressure mm Hg (mean ± SD) following third stage of labor.

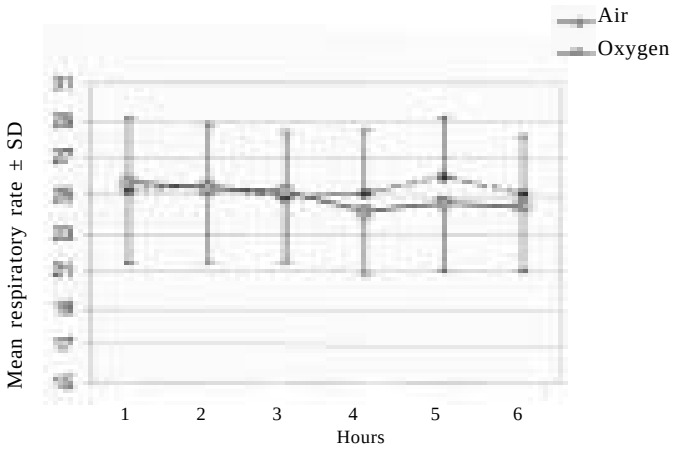

Figure 5. Mean hourly respiratory rate (mean ± SD) following third stage of labor.

Discussion

Many factors are known to affect blood loss after third stage of labor and it was important that we minimized the influence of these factors in the study. Our main outcome variable was vaginal blood loss in women who were receiving active management of third stage of labor in our hospital. We assessed whether oxygen inhalation would be of any additional advantage over and above current standard management of third stage of labor. The duration of the third stage of labor was similar in the study group and the control group.

Our study showned that oxygen inhalation is likely to be effective in reducing the normal vaginal blood loss postpartum. This could be attributed hypothetically to better uterine retraction in the oxygen inhaling group. This pilot data would justify a multicenter study to assess the effect of postpartum oxygen inhalation upon the incidence of post partum hemorrhage. If so confirmed, oxygen inhalation therapy could be an effective, affordable and alternative method to prevent uterine atony and postpartum hemorrhage especially in the developing world. The 6 hour duration of oxygen therapy was determined on the basis that most fatalities due to postpartum hemorrhage were reported within 4 hours of delivery. However, optimum duration of oxygen therapy needed would also have to be assessed later. We also ensured that oxygen inhalation posed no interference in the postnatal mobility and access to the baby for breast-feeding. Lack of breast feeding could affect uterine retraction and possibly the blood loss.

The differences in the behavior of the cardiovascular parameters between the two groups are also interesting. The natural normal vaginal blood loss after delivery should diminish with time and this was reflected in both the groups. However, the trend for a gradual reduction in vaginal blood loss was steeper in the oxygen-inhaling group. Consequently, their cumulative blood loss was also less compared with that in the controls. The differences noted in the cardiovascular parameters between the two groups support above observation. Although there were no significant differences between the two groups in relation to systolic or diastolic blood pressure at any hour during the 6 hours of study the rise in pulse rate in the controls could be argued as a natural compensatory mechanism to counter increased vaginal blood loss.

It was important to ensure that the study group received oxygen throughout 6 hours. The significantly higher peripheral saturations recorded in the oxygen receiving group confirm this. Although the difference in SpO_2 noted was a mean of 2% between the two groups, the partial pressure of oxygen in the arterial blood of the oxygen inhaled group

could have been much greater. This is because the hemoglobin would be fully saturated at a partial pressure of 100 mmHg (oxygen dissociation curve) when breathing room air. The partial pressure of oxygen in arterial blood can be anticipated to exceed 200 mmHg when inhaling 40% oxygen[12]. Therefore, the partial pressure of oxygen in the blood of the oxygen inhaling group would have been twice that of the control group. High partial pressure of oxygen in arterial blood may influence the retraction of myometrial smooth muscles and this may explain the reduced blood loss. Furthermore, high partial pressure of oxygen contributes to maintain a higher muscular tone in blood vessels leading to reduced bleeding. In this context, oxygen therapy may not only be a preventive measure against uterine blood loss after delivery but also a therapeutic tool to enhance myometrial retraction in the affected.

The parity of the women in the two groups and the duration of third stage of labor were not significantly different and therefore parity associated changes in the myometrium (fibrosis and atony) were unlikely to have influenced the outcome in our study.

There are no absolute contraindications or known adverse effects associated with the use of oxygen inhalation in the short term. It is not an invasive procedure. It is not complicated and hence skilled hands are not necessary. Monitoring is not required as it is nontoxic. It is freely available at any basic medial care facility and there is no need for special storage other than the standard cylinders. Therefore, oxygen could be considered a cheap nontoxic uterotonic drug that could be made available in any health care center worldwide irrespective of the economy of a country.

Conclusion

Postpartum oxygen therapy is a safe and desirable modality of therapy that reduces postpartum vaginal loss. Its contribution to a reduction in the incidence of postpartum hemorrhage needs to be studied.

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