

Effect of supplemental oxygen on the incidence and severity of Wound Infection after cesarean surgery

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ABSTRACT

Background: Infection is one of the main concerns in the area of wound healing after surgery. Supplemental oxygen during surgery leads to a reduction of infection and promote healing of ulcers. In the present study the effects of supplemental oxygen therapy has been assessed on the incidence and severity of infection after cesarean.

Methods: This study was a clinical trial in the operating room of Besat hospital in Sannandaj. 122 women have been candidated cesarean surgery that was performed in two groups including intervention and control groups randomly. In the intervention group was used 80 percent equivalent to 12 liter oxygen, using a mask ventury per minute to six hours during surgery and after surgery in recovery and until 6 hours in ward. In the control group was applied routine procedure (30 percent oxygen, equivalent to 3-5 liters per minute with a regular mask). The incidence of wound infection and severity by ASEPPSIS index were after surgery till 14 days.

Results: Based on the results, the incidence of infection of wound 14 days after surgery in intervention and control groups was not significant but severity of infection of wound 14 days after surgery was significant relationship ($p < 0.001$).

Conclusion: This study demonstrated that in order to prevent infection of wound. Supplemental oxygen therapy during and after surgery by spinal anesthesia technique was useful. It is recommended that for the control of postoperative infection control procedures such as the use of a Venturi mask for oxygen therapy patients used.

KEY WORDS: infection, supplemental oxygen therapy, cesarean surgery.

1. INTRODUCTION

Currently, surgery is one of the most basic methods of treatment and it plays a major role in treating the diseases and improving the patients' health (Kaufman, 2015). Despite major progress in the methods of surgery and the cares following it, some complications and side effects such as infection still cause problems for the patients (Ralte, 2015). Further to increasing the caring and treatment costs and elongating the hospitalization period, these infections may also be a considerable threat against the life of the patient (Bakkour, 2016). Despite the various measures taken, surgical wound infection is still one of the important causes of death among the patients and it imposes high costs on the health and treatment system (Shrestha, 2015; Asadbegi, 2016; Ghannad, 2016). Surgical wound infection is one of the important side effects of the surgery which can elongate the hospitalization period of the patients 5 to 20 days and, as a result, increase caring costs (Berry, 2014).

Due to certain reasons, most of the countries around the world including Iran have witnessed a rise in the number and cases of caesarian operation (Sakkaki and Hajimiri, 2012; Rasolabadi, 2015). Nearly 40% of all child deliveries in Iran are conducted through caesarean, while this statistics around the world ranges from 15 to 20 percent (Jouhari, 2014). The greater frequency of caesarean operation has increased the possibility of the side effects of caesarean such as post-surgery infection. These infections and side effects still cause major problems and issues for the patients and the healthcare system (Tuffaha, 2015).

The early hours after surgery are critical and special moments. Infection with bacteria can increase the chance of catching surgical wound infection. Contraction of the vessels caused by the stress of operation in the early hours after surgery may reduce tissue perfusion (Liang, 2014). The level of subcutaneous perfusion and oxygen pressure are important elements which can protect the surgical wound. They can also act as strong criteria to predict infection of surgical wounds (Leaper and Ousey, 2015). Merely using high density oxygen cannot be useful in all operations and prevent infection. Other factors such as hemoglobin levels, blood lost during the operation, length of the operation and the liquids received are factors that also need to be taken into consideration so as to make sure about carrying the oxygen properly (Endo, 2016). Receiving complementary oxygen during the operation through the process of raising the pressure of tissue oxygen and, consequently, improving the mechanism of killing the oxidative of bacteria can reduce wound infections (Helito, 2014).

Some researches indicate that complementary treatment has had no influence on the frequency and intensity of post-operation infections (Pryor, 2004), while oxygen therapy has significantly reduced the frequency and intensity of infection after operation (Hesami, 2008). These differences in the effectiveness of oxygen therapy can

be caused by disturbing variables such as the level of bleeding, the amount of the liquid received, environmental factors, or difference in the density of oxygen therapy and the time of complementary oxygen therapy and type of anesthesia. Noting the control of disturbing variables, the author took the initiative to conduct this research in order to study the influence of complementary oxygen therapy on the frequency and intensity of infection after an efficient caesarean surgery.

2. METHODS

This research was a clinical trial study conducted in the operation room of Besat Hospital of Sanandaj in 2011. The population included all the women booked for caesarean surgery who were supposed to undergo operation that day. After studying the inclusion criteria, the selected patients were divided into the intervention and control group in accordance with the random pair block method. Based on the frequency of surgical wound site infection in the previous studies (Wilson, 1988; Watanabe, 2008) with a certainty of 95% and a power of 80, the population was set to be 126 people according to the statistical formula. After some people left the research units, 61 were left in each group.

The inclusion criteria included taking enough liquids, no history of digestion diseases, no middle ear disease or dizziness, no motion disease, no diabetes or blood pressure, no smoking or alcohol drinking or taking immunosuppressive medicines, no fever of infectious diseases before the operation, having normal weight, fasting 6 to 8 hours before the operation, hemoglobin levels higher than 10 mg/dl before the operation, non-emergency case of operation, and using spinal anesthesia.

The following exclusion criteria were also defined: changing the anesthesia method to general anesthesia for any reason, other marginal operations besides caesarean, long period of anesthesia and unusual bleeding, unusual hemoglobin levels during and after operation, deterioration of the patient's health during the operation and the need for intensive care, and patient's unwillingness to take part in the research after being discharged from the hospital for any reason.

The ethics committee of the university issued the permit required to do the research. Then, the necessary arrangements were made with supervisors of the unit and operation room and anesthesiologist and obstetricians. The patients were given some general information about the goal of the research and their written formal consent was gained to gather information. Then, they received the necessary trainings.

As of methodology, the required instruments for complementary oxygenation such as Venturi mask were prepared and the cooperators were trained about how to use the Venturi mask with a density above 80% during the operation, constantly in recovery and up to 6 hours after the operation. The primary questionnaire was filled. The questionnaires were first completed and fixed by a preliminary study. To check the validity of the questions, five experts were consulted to correct and fix the questions. First, the demographic information of the participants such as age, number of pregnancies, pregnancy time, date of hospitalization, date of discharge and the name of the doctor were written down. The second step checked the patient for lack of background diseases, the pre-operation hemoglobin level, the bleeding level during the operation, the level of the oxygen received during and after operation, and the level of PSO_2 in pulse oximetry. In the third step, the standard tool of ASEPSIS INDEX (Watanabe, 2008) was used to determine the intensity of the surgical wound infection. This is a tool with a high degree of validity and a stability level above 0.80 used to determine the level of infection in many researches (Siriusawakul, 2014). This tool measures the infection of the wound and its recovery based on these criteria: complementary antibiotics therapy (0 – 10 daily scores); redness of the surgical wound site (0 – 5 daily scores); serous discharge of the wound (0 – 5 daily scores); deep rupture of the wound (0 – 10 daily scores); cultivation from the site of the wound and separation of the bacteria (10 scores); debridement of the wound under anesthesia (0 – 10 scores); drainage of the purulent discharge of the wound under local anesthesia (0 – 5 scores); purulent exudate (0 – 10 scores), and hospitalization for more than 14 days (5 scores). As for the measurement of the infection degree, the result of the total sum of the scores gained from the above said criteria was evaluated qualitatively. The total sum of the scores included the following factors: total recovery of the wound (with a score of 0 – 10); disruption of the wound recovery (with a score of 11 – 20); the slight infection of the wound (with a score of 21 – 30); the average infection of the wound (with a score of 31 – 40); and the severe infection of the wound (with a score of 40).

For the validity of the questionnaire, the inter-rater agreement method was utilized. As of the method, the questionnaire and the infection degree measurement tool (ASEPSIS INDEX) were completed simultaneously by two raters for a small group of the patients (10 patients). Based on the Kappa coefficient, the correlation between the scores of the raters ($R = 0.90$) had a high degree of validity.

After preparing the patient on the day of operation, the blood oxygen saturation in the vessel was recorded using pulse oximetry. 15 minutes before anesthesia, 8 ml/kg of Ringer Lactate solution was used. For all the patients, around 2 to 3 milliliter of 0.5 Bupivacaine solution was used using No. 25 Quincke needle (based on the weight and height of the patient) to achieve spinal anesthesia. The first researcher in the operation room who was not involved in data collection used 80% oxygen (equal to 12 liters per minute) for the intervention group during anesthesia,

during operation and after the end of operation continuously in recovery and alternatively in the operation unit for 6 hours using Venturi mask. Routine measures were taken in the control group (30% oxygen equal to 3-5 liters per minute using normal mask).

The status of the wound was scored in the ASEPSIS INDEX while the patient was being discharged. After discharge, one copy of ASEPSIS INDEX was also placed in the patient's file and he was asked to deliver it during his visit. Having made the arrangements with the surgeon, the status of the wound was scored two weeks after the operation during the patient's visit in the office or in the health center and the coded information for each patient was collected and the results were analyzed. If the forms used to study the infections for snatch removal were not returned for any reason, the samples would be excluded and the sampling would continue until the number of the samples in the group reached 60 people.

SPSS win version 20 was used for data analysis. Descriptive statistics was utilized to study the frequency and compare the means. Based on Kolmogorov-Smirnov test and because the frequency of infection, age, length of the operation, hemoglobin levels before operation, average arterial blood pressure, and body temperature during and after the operation exhibited a normal distribution. Independent T-test and X² test were utilized, but due to the abnormal distribution of infection, we utilized Mann-Whitney U statistical test.

3. RESULTS AND DISCUSSION

Based on the results, the minimum age of the patients was 20 years old, while the maximum age was 41. The average age of the patients in the intervention and control groups was 29.70 and 29.26 years old respectively. The results of the statistical tests indicated no significant difference between the two groups in terms of age, BMI, the length of the operation, hemoglobin levels, average arterial blood pressure, the amount of the liquid received, and body temperature before, during, and after the operation (table 1).

Due to utilizing antibiotic prophylaxis, the frequency of intense infection occurrence in the intervention and control group was 0 and 1 respectively. Although the frequency of infection in the control group was more than what was observed in the intervention group, this difference was not statistically significant. However, the statistical test showed that the intensity of infection in the intervention and control groups up to 14 days after the operation exhibited a significant difference. The intensity of infection in the control group was even more ($P < 0.05$) (table 2).

Table.1. A comparison between the mean of the demographic and clinical variables in both groups

Variables	average of the intervention group	average of the control group	test	P-value
age in years	29.70 ± 5.4	29.26 ± 4.6	T	P > 0.05
BMI (kg/m ²)	27.5 ± 5	28 ± 4.5	T	P > 0.05
pre-operation hemoglobin	12.2 ± 2.5	12.5 ± 3	T	P > 0.05
pre-operation WBC	9546.5 ± 1268	10000 ± 2347	T	P > 0.05
pre-operation body temperature	36.4 ± 0.5	36.3 ± 0.6	T	P > 0.05
post-operation body temperature	36.7 ± 0.4	36.5 ± 0.5	T	P > 0.05
body temperature during operation	36.2 ± 0.3	36.3 ± 0.4	T	P > 0.05
length of the operation (min)	57.5 ± 14.2	60 ± 10.4	T	P > 0.05
length of staying in recovery	60 ± 5.5	58.5 ± 6.4	T	p > 0.05
amount of liquids received before operation	600 ± 65	550 ± 78	T	P > 0.05
amount of liquids received during operation	1200 ± 650	1.1 ± 780	T	P > 0.05
amount of liquids received after operation	800 ± 500	850 ± 450	T	P > 0.05
average arterial blood pressure before operation (mm/hg)	12.80 ± 2.50	11.90 ± 2.60	T	P > 0.05
average arterial blood pressure during operation (mm/hg)	11.20 ± 2.2	11.4 ± 2.6	T	P > 0.05
average arterial blood pressure after operation (mm/hg)	10.5 ± 2.80	10.85 ± 2.4	T	P > 0.05

Table.2. A comparison between the intensity of infection in both groups 14 days after caesarean surgery

variable	average rank	Mann-Whitney statistics	P-value
the intensity of infection up to 14 days after caesarean	intervention group = 37.39 control group = 85.61	1236.500	0.001 it is significant

4. DISCUSSION

The results of the present research could not show any influence for oxygen-therapy on the occurrence of infection, however, it could decrease the intensity of the wound site infection. These results were in line with the results of certain studies (Siriussawakul, 2014). For instance, Grief (2000), studied the influence of complementary oxygen on the level of colorectal surgical wound infection. They arrived at the conclusion that extra oxygen can significantly reduce the occurrence of wound infection (Greif, 2000). Another research was conducted by Hopf (1997), to test this hypothesis and see if the pressure of subcutaneous oxygen in the site of the wound can have a correlation with surgical wound infection and predict it. They arrived at the conclusion that the level of subcutaneous perfusion and subcutaneous oxygen pressure are the important elements for protecting surgical wound. Thus, they can act as strong criteria to predict surgical wound infection (Hopf, 1997).

Hesami (2008), conducted a research to study the influence of the prescribed oxygen during anesthesia on the occurrence frequency of wound infection in clean-dirty operations in Imam Reza Hospital of Kermanshah. The control groups received 40% FIO₂, while the intervention group had received 80% FIO₂ during anesthesia. The two groups were then studied for two weeks to check their signs of wound infection. Out of 292 people who had received 80% FIO₂, 11 (3.9%) got afflicted with wound infection, while 25 (8.1%) of those 292 people receiving 40% FIO₂ were diagnosed with wound infection. With a possible error rate of 5% (alpha), the prevalence of wound infection in the group receiving more FIO₂ oxygen was significantly less than the group who had received less FIO₂ oxygen. As for the conclusion, this study also confirmed the positive influence of extra oxygen during operation to reduce wound infection in dirty clean operations. Considering the fact that this method is safe, cheap and effective in reducing wound infection of the patient, using extra oxygen during clean-dirty operations is recommended (Hesami, 2008).

Despite some similarities, the results of this research were different from some other studies. The reason for this difference was controlling some of those confounding variables in our research. Inanmaz (2014), believes that the type of the operation, method of anesthesia and patient's condition such as obesity, gender, age, pre-operation anxiety, the amount of the liquids received, the amount of the oxygen consumed, and blood circulation state of the patient can determine the occurrence and post-surgery side effects (Inanmaz, 2014). Priver (2000), studied the effect of oxygen therapy during the operation on post-operation infection levels in two groups receiving 80% oxygen and 30% oxygen. The signs of the infection were examined during a period of 14 days after the operation using surgical site infection (SSI) tools. The results indicated no significant difference between the two groups. Further to those results and keeping in mind the fact that obesity was not considered as the predictive factor and other variables such as the amount of the liquids received and the length of the operation were not taken into consideration, thus, merely applying high density oxygen can be effective in all operations to prevent infection. Other factors such as levels of hemoglobin, blood lost during the operation, length of the operation and the liquids received also need to be taken into consideration to be assured of proper oxygen transfer (Pryor, 2004). Due to the influence of confounding variables, the researcher took the appropriate measures to control them. The difference between the results of our research and other studies is due to controlling the confounding variables.

Noting the previous studies, different results have been achieved concerning the influence of complementary oxygen therapy on the frequency of occurrence and intensity of surgical site infection. This difference can be attributed to confounding variables such as the level of bleeding, the amount of the liquids received, environmental factors, or difference in the density utilized for oxygen therapy and the length of oxygen therapy and type of anesthesia.

The present research managed to reduce the gap in the studies caused by confounding variables. Considering the control of confounding variables such as using the proper density of oxygen (80% roughly equal to 12 liters of oxygen with Venturi mask for the groups studied and 30% oxygen equal to 3 liters of oxygen with normal mask in the control groups) and evaluating the occurrence frequency and the intensity of surgical site infection among the patients undergoing caesarean, the adverse influence of the confounding variables was controlled and caused the difference between the results of this research and other similar studies conducted in this field. One of the limitations of this research was tracing the occurrence frequency of the infection up to 14 days after the operation. Further studies are recommended to be conducted over a larger and longer scope of time. This research is suggested to be conducted in other types of surgery and with varying particles of oxygen.

5. CONCLUSION

It turned out that caesarean operation which is followed by spinal anesthesia, losing liquids, blood pressure drop, opening of abdomen and stimulation of the intestines, using high levels of oxygen can increase the pace of wound recovery after operation and prevent surgical site intense infection. Thus, complementary oxygen therapy is recommended as a cheap and safe way to recover surgical wounds.

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