Archives of Clinical and Experimental Surgery
2021 VOL 10, NO. 1, PAGE 32-37

RESEARCH ARTICLE

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Role of Supplemental Oxygen in Perioperative Period for Reducing Surgical Site Infection: A Comparative Hospital Based Study

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ABSTRACT

Introduction: Sepsis has been regarded as an insult to the surgeon and surgeons are always in search of methods of reducing and minimising the occurrence of post-surgical infection and sepsis. There are various factors, which predispose to SSI including host factors and environmental factors. The host-derived factors which contribute importantly to the risk of SSI, include, age, obesity, malnutrition, diabetes mellitus, hypocholesterolemia, immunocompromised states, hypoalbumenemia and several other factors not accounted for by National Nosocomial Infections Surveillance (NNIS) System. Intraoperative hypothermia is also associated with an increased incidence of SSIs following many operations. We performed a study to evaluate the role of perioperative orthobaric supplemental oxygen therapy (high FIO2) in preventing the occurrence of surgical Site Infections (SSIs).

Materials and methods: A total of 100 patients were included in the study. Patients were divided into two groups alternately with 50 patients in each group. Both the groups were matched in age, sex and type of surgery. One group (Study group) was subjected to peri-operative oxygen supplementation (high FIO2; 60% oxygen) and the other group (Control group) was subjected to (30% oxygen) perioperatively. The patients in the study group received 60% fraction of inspired oxygen intra-operatively and 2 hours post operatively, the other group received room air post operatively. Patients of both groups were observed for the occurrence of wound infection. The wound infection was diagnosed clinically by the presence of clinical signs including local induration, erythema, tenderness, warmth, wound discharge, crepitus etc. described by the Centers for Disease Control Recommendations to Prevent Surgical Site Infections.

Observations: In our study, in a total of 100 patients, 50 belonged to control group and 50 to study group. The male female ratio was 26:24 in control group and 28:22 in study group respectively. The mean age of patients in our study was 39.52 ± 11.55 years, while as the mean age in study group was 39.8 ± 11.18 years and in control group was 39.27 ± 12.02 years. In our study, the Mean BMI of patients in the Study Group was 21.7 ± 9.2 and the mean BMI of the Control Group was 23.7 ± 8.6. The difference was however statistically insignificant. P-Value being 0.78. In our study we observed that the infection rate in the study group who received 60% fraction of inspired oxygen perioperatively was 20%, i.e 10 out of 50 patients developed surgical site infections while as in control group who received 30% fractions of inspired oxygen perioperatively, 36% of patients i.e 18 out of 50 (control group) patients developed surgical site infections. The difference between the two groups was statistically significant with p value of 0.043676.

Conclusion: we concluded that the use of hyperoxygenation throughout the surgical interventions in different elective surgeries has a major effect on the frequency of SSI without an increase in the frequency of adverse effects.

ARTICLE HISTORY
Received: November 23, 2020
Accepted: December 7, 2020
Published: December 14, 2020

KEYWORDS
Sepsis, SSI, Perioperative oxygen therapy

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Introduction

Traditionally, Sepsis has been regarded as an insult to the surgeon and surgeons are always in search of methods of reducing and minimising the occurrence of post-surgical infection and sepsis. Still Infection forms a major complication of surgical procedures, and among surgical patients, surgical site infection (SSI) is the most common nosocomial infection reported [1]. SSIs prolong hospital stay, increase the cost of care, and are associated with increased mortality [1-3]. There are various factors, which predispose to SSI including host factors and environmental factors. The host-derived factors which contribute importantly to the risk of SSI, include, age, obesity, malnutrition, diabetes mellitus, hypocholesterolemia, immunocompromised states, hypoalbumenemia and several other factors not accounted for by National Nosocomial Infections Surveillance (NNIS) System [4-6]. Intraoperative hypothermia is also associated with an increased incidence of SSIs following many operations [7]. Determining the avoidable factors that affect SSI can therefore allow to improve the outcome after surgery [8]. The risk of infection at a surgical site is related to the number of bacteria that reach the surgical wound and the body's ability to kill these bacteria within the first few hours of the wound-healing process [9]. Destruction by oxidation or oxidative killing is one of the most important defences against surgical pathogens and depends on the partial pressure of oxygen in contaminated tissues [10]. Although controversial whether perioperative oxygen administration is beneficial for the prevention of infection, Oxygen partial pressures and wound tissue oxygen tensions have been shown to correlate with oxidative killing and have been reported to predict SSI rates [11,12]. We therefore performed a study to evaluate the role of perioperative orthobaric supplemental oxygen therapy (high FIO2) in preventing the occurrence of surgical Site Infections (SSIs).

Materials and Methods

The study was a comparative study conducted in the Postgraduate Department of General Surgery, Government Medical College Srinagar at SMHS Hospital from August 2016 to March 2018. A total of 100 patients were included in the study. Patients were divided into two groups alternately with 50 patients in each group. Both the groups were matched in age, sex and type of surgery. One group (Study group) was subjected to peri-operative oxygen supplementation (high FIO2; 60% oxygen) and the other group (Control group) was subjected to (30% oxygen) perioperatively. The patients in the study group received 60% fraction of inspired oxygen intra-operatively and 2 hours post operatively, the other group received room air post operatively. During intra-operative period, the oxygen was delivered by Boyle's apparatus 60% under general anaesthesia. Postoperatively oxygen was delivered through Poly mask at a rate of 6 lits/min in study group and 3 lits/min in other group. Operative wounds were examined on second, fifth and eighth postoperative days for the signs of SSI. Follow up was done for 30 days. Patients of both groups were observed for the occurrence of wound infection. The wound infection was diagnosed clinically by the presence of clinical signs including local induration, erythema, tenderness, warmth, wound discharge, crepitus etc. described by the Centers for Disease Control Recommendations to Prevent Surgical Site Infections [13].

Inclusion Criteria

All operated patients with clean (Class I) and clean contaminated (Class II) wounds between 15-60 years of age.

Exclusion Criteria

- Patients with contaminated (Class III) and dirty-infected wounds (Class IV)
- American Society of Anesthesiology class 3 and above and moribund patient populations
- Purely laparoscopic (non–hand-assisted) procedures
- Minor outpatient (day-case) surgery cases
- Neonatal cases

Results and Observations

In our study, in a total of 100 patients, 50 belonged to control group and 50 to study group. The male female ratio was 26:24 in control group and 28:22 in study group respectively as shown in Figure 1 (p-value being)

The mean age of patients in our study was 39.52 ± 11.55 years, while as the mean age in study group was

39.8 ± 11.18 years and in control group was 39.27

± 12.02 years as shown in the Figure 2 (P-value being)

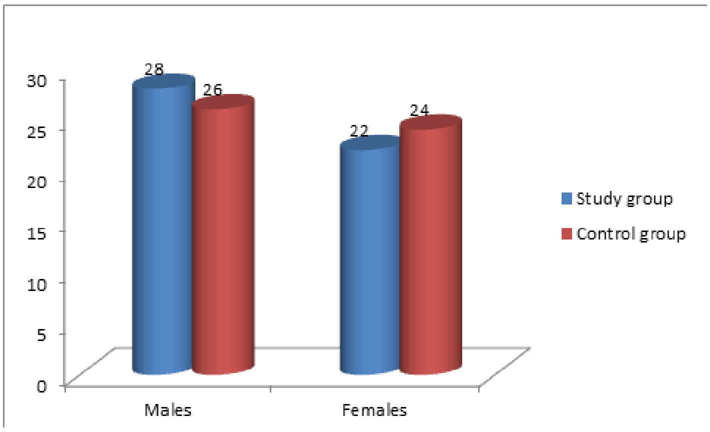

Figure 1. Graph showing Gender distribution of patients in our study.

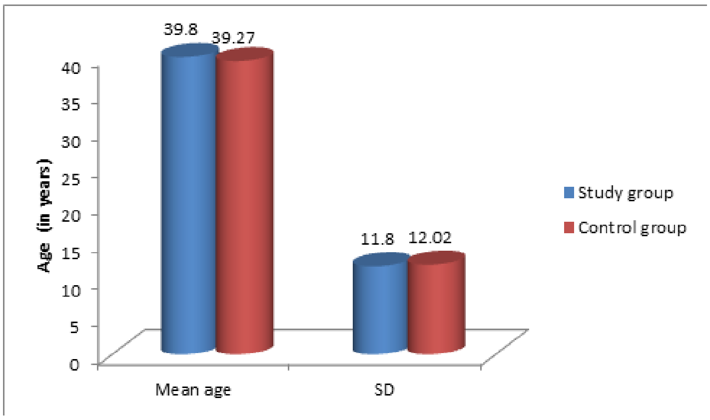

Figure 2. Graph showing Gender Difference of patients in between Age group and Mean age group.

In our study, the Mean BMI of patients in the Study Group was 21.7 ± 9.2 and the mean BMI of the Control Group was 23.7 ± 8.6. The difference was however statistically insignificant. P-Value being 0.78 shown in the Figure 3 (P-value being)

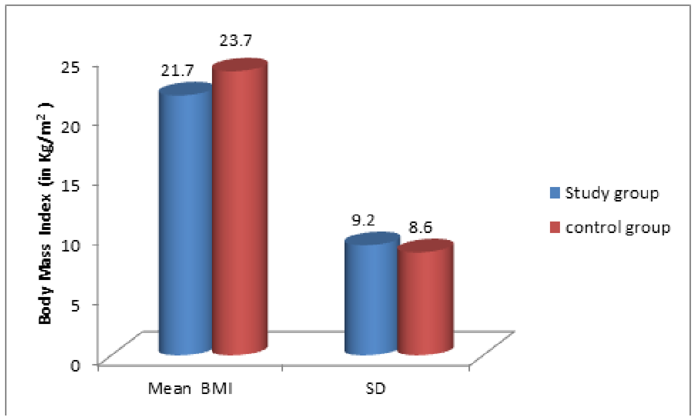

Figure 3. Graph showing Gender Difference of patients in between Body mass Index and Mean BMI.

The Various surgical procedures done in class-1 category patients are cholecystectomy, hernia repair, mastectomy, parathyroidectomy, thyroidectomy,and lipoma excision as shown in Table 1. Out of these proceduresCholecystectomy (open) was the major procedure.

The various class II surgical procedures (clean contaminated) done in the two groups in our study were shown Table 2.

Class I Surgeries	Control Group		Study Group		Total	
	N	%	N	%	N	%
Cholecystectomy (open)	20	40.00%	12	24.00%	32	64.00%
Hernia Repair		0.00%	1	2.00%	1	2.00%
Lipoma excision	1	2.00%	1	2.00%	2	4.00%
Mastectomy (MRM)	7	14.00%	4	8.00%	11	22.00%
Parathyroidectomy	1	2.00%		0.00%	1	2.00%
Thyroidectomy	1	2.00%	2	4.00%	3	6.00%
Grand Total	30	60.00%	20	40.00%	50	100.00%

Table 1. Types of surgeries (Class-I).

Class II Surgeries	Control Group		Study Group		Total	
	N	%	N	%	N	%
Right Hemicolectomy	1	2.00%	8	16.00%	9	18.00%
Left Hemicolectomy	5	10.00%		0.00%	5	10.00%
Pyelolithotomy	8	16.00%	10	20.00%	18	36.00%
LAR	2	4.00%	5	10.00%	7	14.00%
Appendectomy	1	2.00%		0.00%	1	2.00%
Gastrectomy	3	6.00%	4	8.00%	7	14.00%
Nephrolithotomy		0.00%	3	6.00%	3	6.00%
Grand Total	20	40.00%	30	60.00%	50	100.00%

Table 2. Types of surgeries (Class-II).

In our study we observed that the infection rate in the study group who received 60% fraction of inspired oxygen perioperatively was 20%, i.e 10 out of 50 patients developed surgical site infections while as in control group who received 30% fractions of inspired oxygen perioperatively, 36% of patients i.e 18 out of 50 (control group) patients developed surgical site infections Table 3. The difference between the two groups was statistically significant with p value of 0.043676.

Table 3. Surgical Site infections.

Surgical site infection	Control Group	Study Group	Total
No	32	40	72
Yes	18	10	28
Grand Total	50	50	100
P value = 0.043676	40.00%	40.00%	40.00%

Discussion

Surgical site infection (SSI) is a major complication of surgery, associated with prolonged hospitalization, increased costs and increased morbidity and mortality. In recent years, randomized trials have identified a number of preventive measures that can substantially reduce the risk of SSI. These include appropriate perioperative antibiotic prophylaxis, maintenance of perioperative normothermia and control of hyperglycaemia. The effect of perioperative oxygen supplementation continues to be under debate with proponents and opponents firmly divided over the issue. Number of studies have been conducted to assess the benefits of such perioperative oxygen therapy in preventing SSIs which have however yielded mixed results [11,14]. While some have shown a considerable reduction in the incidence of SSI, others have found an increased risk of SSI in patients receiving supplemental oxygen [10,14]. While a higher concentration of oxygen supplementations (80%) has been found to reduce the SSIs by half, inspiring a higher concentration of oxygen is not devoid of complications [12,15]. It can induce lung injury and atelectasis in patients at risk [16,17]. Therefore, this study was performed to evaluate the role of perioperative supplemental oxygen therapy (high FIO2) in preventing the occurrence of surgical Site Infections (SSIs). In our study, we divided patients in two groups, 50 patients in control group and 50 in study group. The male female ratio was 26:24 in control group and 28:22 in study group respectively. In our study, the mean age of total study population (100) was 39.52 ± 11.55 years. The mean age in study group (50) was

39.8 ± 11.18 years and 39.27 ± 12.02 years in the control group respectively. Mean BMI of the Study group and control group in our study was 21.7 ± 9.2 and 23.7 ± 8.6 respectively. Mean BMI between the two groups was compared and there was no significant statistical differences observed in the BMI between the two groups

(p value 0.78) which supports the findings of Pascal Thibon, et al, 2012 as they found in their study, the body mass index (27.1) of study group versus control group (26.5) was statically non-significant [18]. In our study, we observed that 10 out of 50 patients in study group who received 60% Fio2 perioperatively developed surgical site infection while as in control group that received Fio2 30%; 18 out of 50 patients developed wound infection. On comparing these results, we observed a statistically significant difference in the infection rates between the two groups (P value=0.043676). this is consistane with the findings of Tejaswini Vallabha, et al 2016; Belda FJ et al; Ahmad Al Niamiet al 2008 and Motaz Qadan et al 2009 who also have reported that oxygen supplementation in perioperative period resulted in a significant reduction in surgical site infection rates in clean and clean contaminated surgeries [19-22].

Conclusion

From this study, we concluded that the use of hyperoxygenation throughout the surgical interventions in different elective surgeries has a major effect on the frequency of SSI without an increase in the frequency of adverse effects. So, from the results of this study, we recommend the use of 60% supplemental perioperative oxygen in patients undergoing general surgical procedures as a cheap and safe method of reducing the risk of surgical site infections.

Conflict of Interest

The authors declare no conflict of interest.

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