E-ISSN: 2616-3470
P-ISSN: 2616-3462

www.surgeryscience.com
2021; 5(2): 11-20
Received: 05-02-2021
Accepted: 09-03-2021

Dr. Ravikiran HR
Assistant Professor, Department of Surgery, Sri Devaraj Urs Academy of Higher Education & Research, Tamaka, Kolar, Karnataka, India

Dr. Murakonda Sowmya Chowdary
Junior Resident, Department of Surgery, Sri Devaraj Urs Academy of Higher Education & Research, Tamaka, Kolar, Karnataka, India

Dr. Shashirekha C A
Professor, Department of Surgery, Sri Devaraj Urs Academy of Higher Education & Research, Tamaka, Kolar, Karnataka, India

Dr. Krishna Prasad K
Professor & HoD, Department of Surgery, Sri Devaraj Urs Academy of Higher Education & Research, Tamaka, Kolar, Karnataka, India

Corresponding Author:
Dr. Murakonda Sowmya Chowdary
Junior Resident, Department of Surgery, Sri Devaraj Urs Academy of Higher Education & Research, Tamaka, Kolar, Karnataka, India

To compare effectiveness of post operative supplemental oxygen on surgical site infection in high risk cases

Dr. Ravikiran HR, Dr. Murakonda Sowmya Chowdary, Dr. Shashirekha C A and Dr. Krishna Prasad K

DOI: https://doi.org/10.33545/surgery.2021.v5.i2a.653

Abstract
Introduction: Surgical site infection (SSI) is a common complication after surgery and has a negative impact on clinical outcomes and healthcare costs. The reported incidence of SSI after abdominal surgery ranges from 10-30%. The use of supplemental oxygen to prevent SSI is thought to enhance innate defence mechanisms against surgical pathogens that are neutralised mainly by the neutrophil-mediated oxidative burst. This effect is related to tissue partial pressure of oxygen (PtsO2), which in turn is directly dependent on arterial partial pressure of oxygen (PaO_2). Hence, an association between PaO2 and SSI has always been suggested. Hence a comparative study is undertaken to study the effectiveness of supplemental oxygen in the post-operative period in cases which have high risk of developing surgical site infection.
Materials and Methods: A prospective Cohort study to evaluate the effectiveness of supplemental oxygen in the post-operative period in high risk abdominal surgeries is performed from Sept 2020- Jan 2021 in R L Jalappa hospital, Kolar. Cases were allocated to study group (Group A) and control group (Group B) by simple random sampling. The results were analysing using SPSS.22VERSION software.
Results: There was no significant difference in mean age comparison, duration of procedure, sex distribution and drainage of pus between the two groups. Significant difference was noted in serous discharge, purulent discharge, erythema, separation of tissues distribution between two groups from Day 1 to Day 5. Out of 28 patients in Group A, 16 (57.14%) patients had satisfactory healing, 11 (39.29%) had disturbance of healing and 1 (3.57%) had mild wound infection. Out of 28 patients in Group B, 6 patients (21.42%) had satisfactory healing, 16 (57.14%) had disturbance of healing, 3 (10.71%) had mild wound infection, 2 (7.14%) had moderate wound infection and 1(3.57%) had severe wound infection. SSI was seen more in Group B compared to Group A.
Conclusions: Post op supplementation of oxygen in high risk emergency abdominal surgeries reduces the incidence of SSI.

Keywords: Post-operative oxygen supplementation, Surgical site infection, post-operative complications, surgery

Introduction
Surgical site infection (SSI) is a common complication following abdominal surgeries. Surgical wounds are classified as
1. Clean – If it involves only skin and soft tissue
2. Clean contaminated – If any hollow viscus is opened in elective conditions
3. Contaminated – If there is gross inoculation into a sterile body cavity (e.g.-perforated hollow viscous).
4. Dirty- If there is an already established infective foci (e.g.-Perforated diverticulitis, appendicular abscess.)

The incidence of SSI range from <5% in clean cases to <20% in emergency surgeries performed on dirty wounds. Many studies have shown variable results with respect to effect of perioperative oxygen supplementation in reducing SSI.
We have under taken a prospective Cohort study to assess the effectiveness of post-operative supplemental oxygen in high risk (i.e. contaminated and dirty wounds) abdominal surgeries.

AIMS and Objectives
To determine the effectiveness of post-operative oxygen supplementation in high risk abdominal surgeries in reducing the incidence of SSI.

Materials and Methods

Study design – Prospective cohort study

Description of intervention

Patients are divided into study group (Group A) and control group (Group B). Study group receives post-operative oxygen supplementation at the rate of 5L/min through facemask for the initial 24hrs and control group do not receive any supplementation.

Study population

Patients undergoing emergency abdominal surgeries in R L Jalappa Hospital from Sept 2020 to January 2021 are selected for the study.

Inclusion criteria

Age group between 18-65yrs

Patients undergoing emergency abdominal surgeries.

Exclusion criteria: Patients having co morbid conditions which confound the results like DM, hypoproteinemia, immunosuppression, CT/RT, anaemia, atherosclerosis, pregnancy, chronic renal / liver diseases.

Sampling procedure: Cases are allocated to study group (Group A) and control group (Group B) by simple randomization technique.

Sample size: Sample size was calculated using OpenEpi software (CI 95%), 56 cases were selected by simple random technique from the in patients admitted in Department of General Surgery RLJH Hospital, who underwent emergency surgeries from Sept 2020 to January 2021.

Data collection: Data was collected using a proforma which include patient demographic detailed history and clinical examination, relevant investigations, operative procedure, signs of surgical site infections such is observed in both the groups using ASEPSIS CRITERIA in post op period.

Statistical analysis

Data was entered into Microsoft excel data sheet and was analysed using SPSS 22 version software. Categorical data was represented in the form of Frequencies and proportions. Chi-square test was used as test of significance for qualitative data. Continuous data was represented as mean and standard deviation. Independent t test was used as test of significance to identify the mean difference between two quantitative variables.

Graphical representation of data: MS Excel and MS word was used to obtain various types of graphs such as bar diagram.

p value (Probability that the result is true) of <0.05 was considered as statistically significant after assuming all the rules of statistical tests.

Statistical software: MS Excel**,** SPSS version 22 **(**IBM SPSS Statistics, Somers NY, USA) was used to analyse data.

Results

Total 56 patients were included in this study, 28 were included under Group A (Study Group) and 28 in Group B (Control Group).

Table 1: Mean Age Comparison between two groups

	Group				p value
	Group A		Group B		
	Mean	SD	Mean	SD	
Age	40.14	22.1	38.64	18.32	0.783

Mean Age in Group A was 40.14 ± 22.1years and in Group B was 38.64 ± 18.32.

There was no significant difference in mean age comparison between two groups.

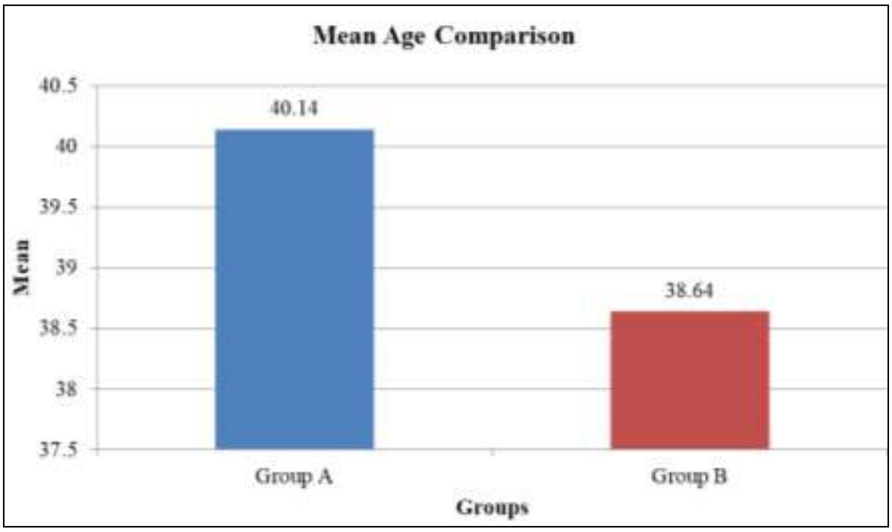

Fig 1: Bar Diagram Showing Mean Age Comparison between two groups

Table 2: Mean Duration of Procedure Comparison between two groups

	Group				p value
	Group A		Group B		
	Mean	SD	Mean	SD	
Duration of procedure (min)	145.18	75.28	145.71	63.49	0.977

Mean Duration of procedure in Group A was 145.18 ± 75.28 and in Group B was 145.71 ± 63.49.

There was no significant difference in mean Duration of procedure comparison between two groups.

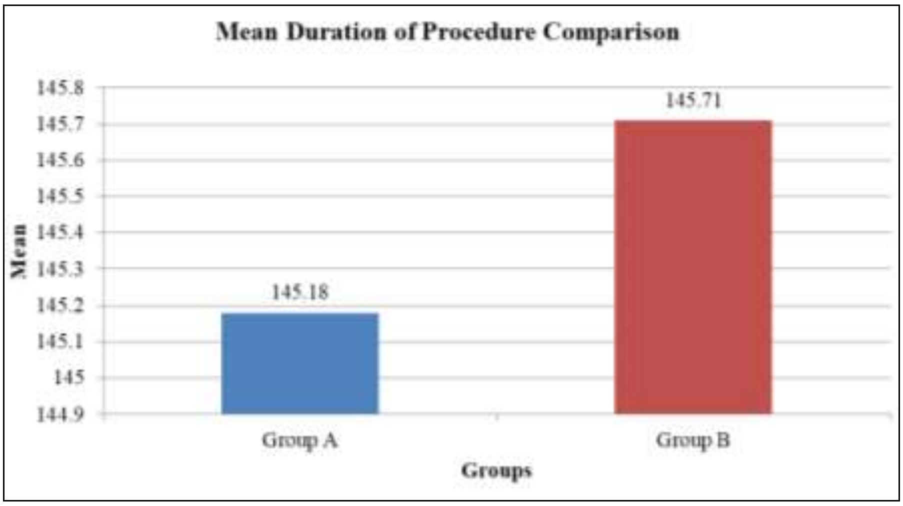

Fig 2: Bar Diagram Showing Mean Duration of Procedure Comparison between two groups

Table 3: Sex Distribution between two groups

		Group			
		Group A		Group B	
		Count	%	Count	%
Sex	Female	10	35.71%	8	28.57%
	Male	18	64.29%	20	71.43%

$\chi2 = 0.327$, df = 1, p = 0.567

In Group A, 35.71% were Female and 64.29% were Male.
In Group B, 28.57% were Female and 71.43% were Male.

There was no significant difference in Sex Distribution between two groups.

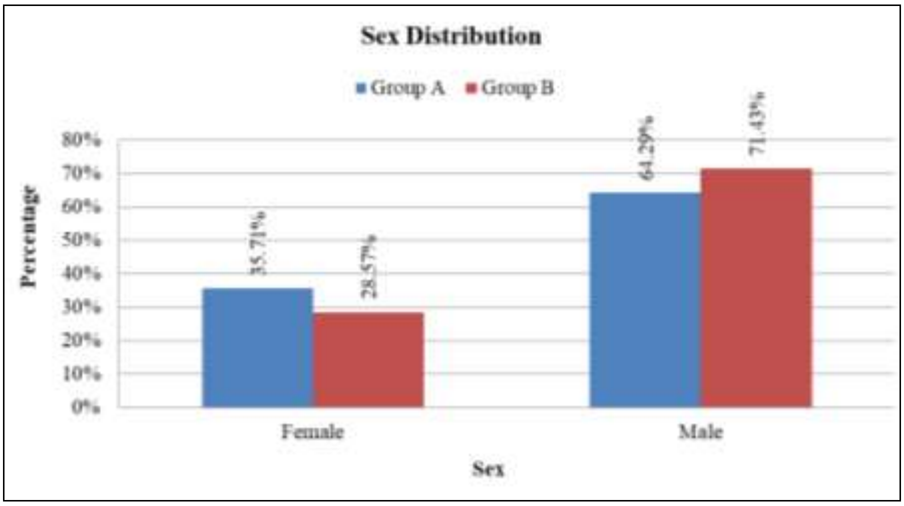

Fig 3: Bar Diagram Showing Sex Distribution between two groups

Table 4: Type of Wound Distribution between two groups

		Group			
		Group A		Group B	
		Count	%	Count	%
Type of wound	Clean contaminated	28	100.00%	28	100.00%

Table 5: Drainage of pus Distribution between two groups

		Group			
		Group A		Group B	
		Count	%	Count	%
Drainage of pus	No	27	96.43%	23	82.14%
	Yes	1	3.57%	5	17.86%

$\chi2 = 2.987$, df = 1, p = 0.084

In Group A, 3.57% had drainage of pus and in Group B, 17.86% had drainage of pus.

There was no significant difference in drainage of pus distribution between two groups.

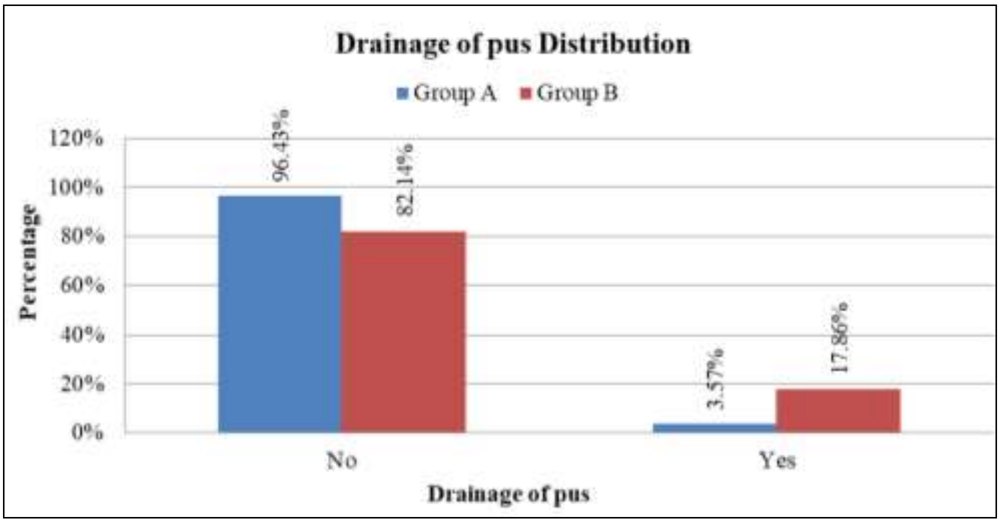

Fig 5: Bar Diagram Showing Drainage of Pus Distribution between two groups

Table 6: Debridement Distribution between two groups

		Group			
		Group A		Group B	
		Count	%	Count	%
Debridement	No	28	100.00%	28	100.00%

Table 7: Grade Distribution between two groups

		Group			
		Group A		Group B	
		Count	%	Count	%
Grade	Satisfactory healing	16	57.14%	6	21.42%
	Disturbance of healing	11	39.29%	16	57.14%
	Mild wound infection	1	3.57%	3	10.71%
	Moderate wound infection	0	0.00%	2	7.14%
	Severe wound infection	0	0.00%	1	3.57%

$\chi 2 = 12.471$, df = 4, p = 0.029*

In Group A, 57.14% had satisfactory healing, 39.29% had disturbance of healing and 3.57% had mild wound infection.
In Group B, 21.42% had satisfactory healing, 57.14% had disturbance of healing, 10.71% had mild wound infection, 7.14% had moderate wound infection and 3.57% had severe wound infection.
There was a significant difference in Grade Distribution between two groups.

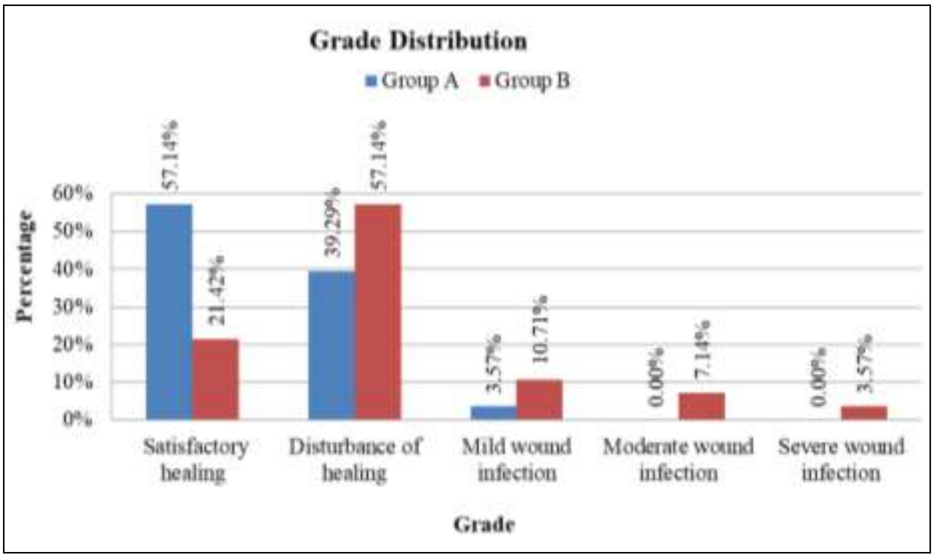

Fig 6: Bar Diagram Showing Grade Distribution between two groups

Table 8: Mean Final Total Score Comparison between two groups

	Group				p value
	Group A		Group B		
	Mean	SD	Mean	SD	
Final Total score	9.68	5.57	16.32	9.11	0.002*

Mean Final Total score in Group A was 9.68 ± 5.57 and in Group B was 16.32 ± 9.11.
There was a significant difference in mean Final Total score comparison between two groups.

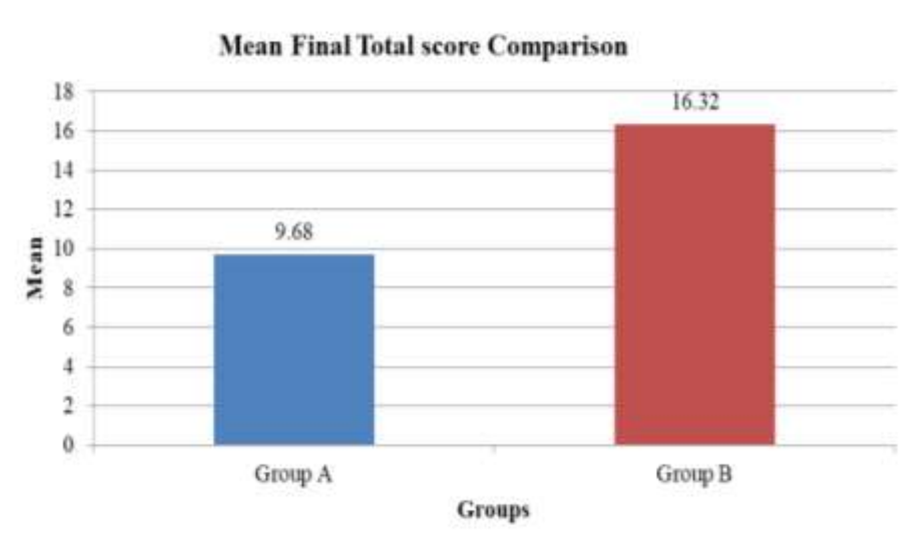

Fig 7: Bar Diagram Showing Mean Final Total Score Comparison between two groups

Table 9: Serous Discharge Distribution between two groups

Serous discharge		Group				Chi Square
		Group A		Group B		
		Count	%	Count	%	
Day 1	Minimal	0	0.00%	6	21.43%	χ2 = 6.72, df = 1, p = 0.010*
	No	28	100.00%	22	78.57%	
Day 2	Minimal	3	10.71%	13	46.43%	χ2 = 8.75, df = 1, p = 0.003*
	No	25	89.29%	15	53.57%	
Day 3	Minimal	5	17.86%	19	67.86%	χ2 = 14.292, df = 1, p = < 0.001*
	No	23	82.14%	9	32.14%	
Day 4	Minimal	11	55.00%	11	91.67%	0.030*
	No	9	45.00%	1	8.33%	
Day 5	Minimal	10	58.82%	9	100%	0.024*
	No	7	41.18%	0	0.00%	
Day 6	Minimal	5	83.33%	0	0.00%	-
	No	1	16.67%	0	0.00%	
Day 7	Minimal	3	75.00%	0	0.00%	-
	No	1	25.00%	0	0.00%	

There was a significant difference in Serous Discharge Distribution between two groups from Day 1 to Day 5.

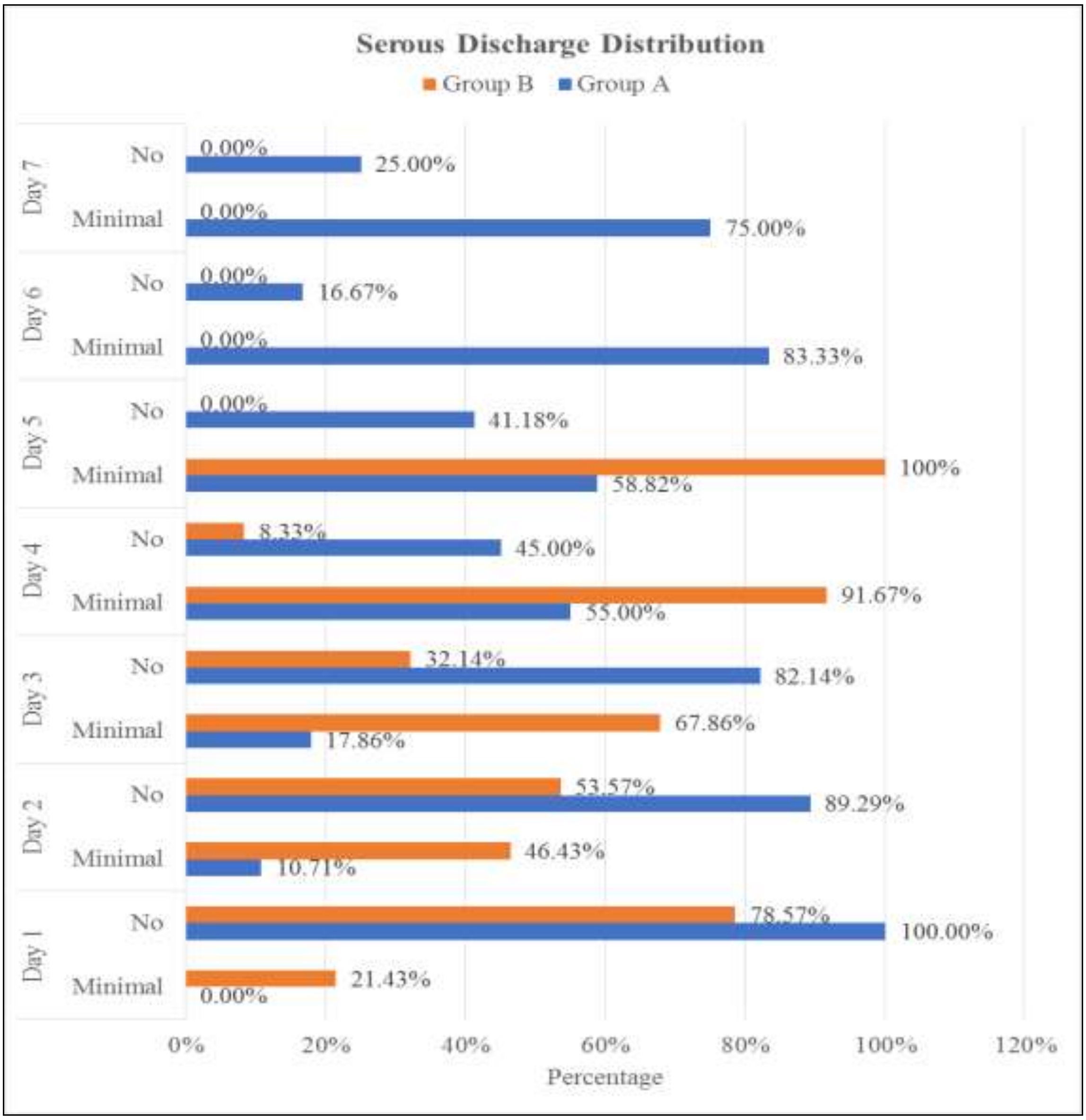

Fig 8: Column Diagram Showing Serous Discharge Distribution between two groups

Table 10: Purulent Discharge Distribution between two groups

Purulent Discharge		**Group**				**Chi Square**
		Group A		**Group B**		
		Count	**%**	**Count**	**%**	
Day 1	Minimal	0	0.00%	4	14.29%	χ2 = 4.308, df = 1, p = 0.038*
	No	28	100.00%	24	85.71%	
Day 2	Minimal	0	0.00%	6	21.43%	χ2 = 6.72, df = 1, p = 0.010*
	No	28	100.00%	22	78.57%	
Day 3	Minimal	0	0.00%	14	50.00%	χ2 = 18.667, df = 1, p = < 0.001*
	No	28	100.00%	14	50.00%	
Day 4	Minimal	0	0.00%	8	66.67%	< 0.001*
	No	20	100.00%	4	33.33%	
Day 5	Minimal	2	11.76%	9	100.00%	0.014*
	No	15	88.24%	0	0.00%	
Day 6	Minimal	2	33.33%	0	0.00%	-
	No	4	66.67%	0	0.00%	
Day 7	Minimal	3	75.00%	0	0.00%	-
	No	1	25.00%	0	0.00%	

There was a significant difference in Purulent Discharge Distribution between two groups from Day 1 to Day 5.

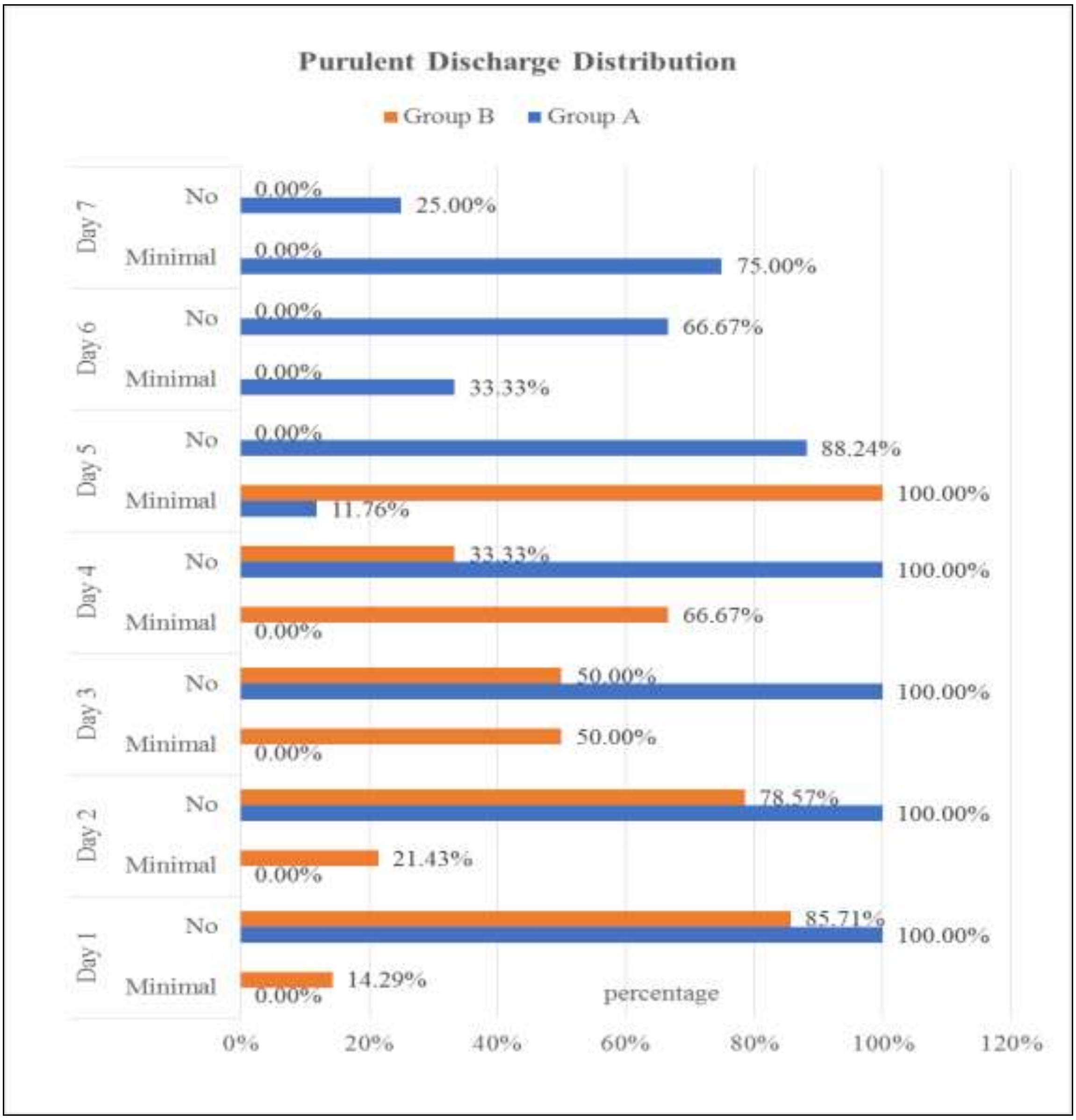

Fig 9: Bar Diagram Showing Purulent Discharge Distribution between two groups

Table 11: Erythema Distribution between two groups

Erythema		Group A		Group B		Chi Square
		Count	%	Count	%	
Day 1	Mild	0	0.00%	3	10.71%	χ2 = 3.17, df = 1, p = 0.075
	No	28	100.00%	25	89.29%	
Day 2	Mild	0	0.00%	6	21.43%	χ2 = 6.72, df = 1, p = 0.010*
	No	28	100.00%	22	78.57%	
Day 3	Mild	0	0.00%	14	50.00%	χ2 = 18.667, df = 1, p = < 0.001*
	No	28	100.00%	14	50.00%	
Day 4	Mild	0	0.00%	10	83.33%	< 0.001*
	No	20	100.00%	2	16.67%	
Day 5	Mild	3	17.65%	9	100.00%	< 0.001*
	No	14	82.35%	0	0.00%	
Day 6	Mild	3	50.00%	0	0.00%	-
	No	3	50.00%	0	0.00%	
Day 7	Mild	2	50.00%	0	0.00%	-
	No	2	50.00%	0	0.00%	

There was a significant difference in Erythema Distribution between two groups from Day 1 to Day 5.

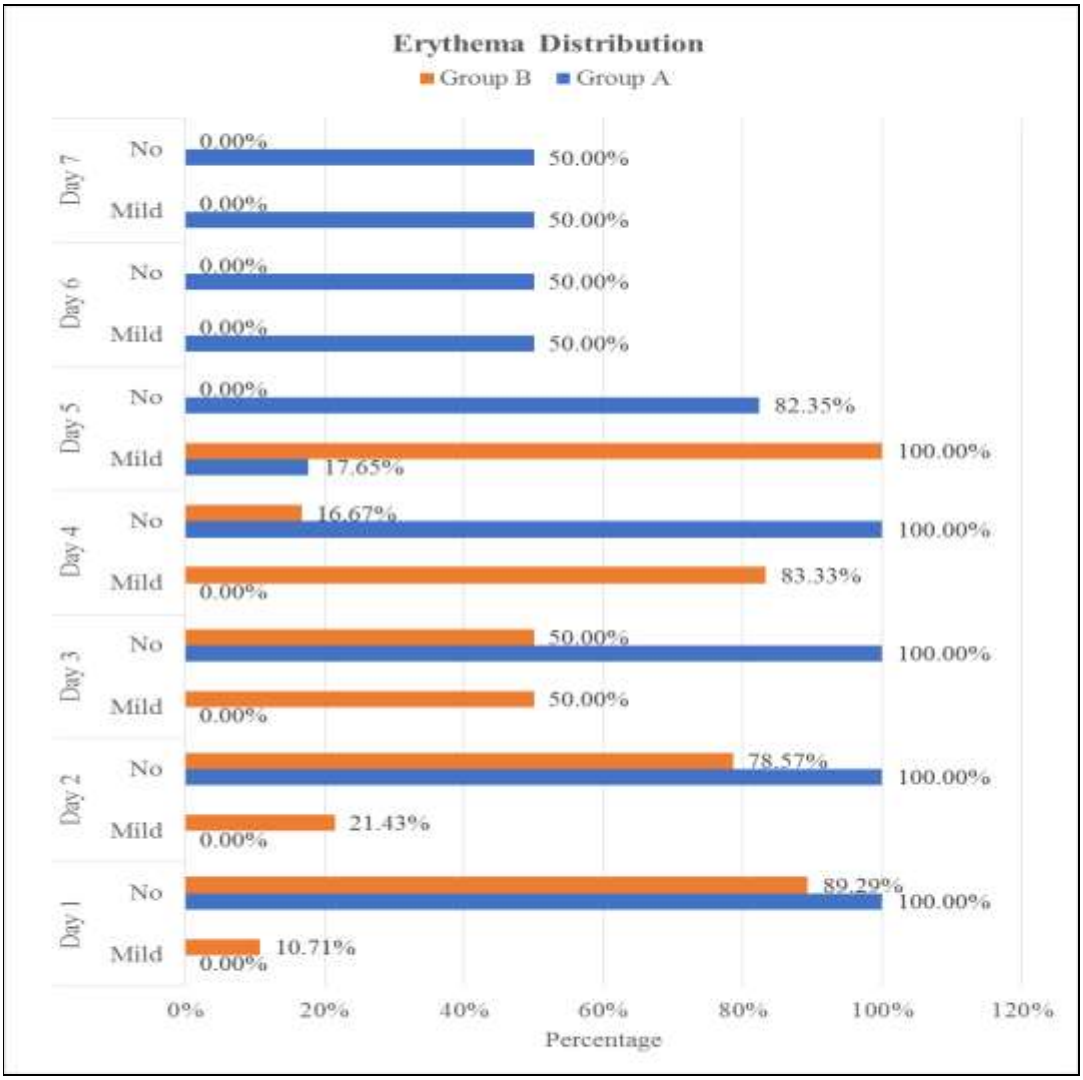

Fig 10: Column Diagram Showing Erythema Distribution between two groups

Table 12: Separation of Tissues Distribution between two groups

Separation of tissues		**Group**				**Chi Square**
		Group A		**Group B**		
		Count	**%**	**Count**	**%**	
Day 1	No	28	100.00%	28	100.00%	
Day 2	No	28	100.00%	27	96.43%	χ2 = 1.018, df = 1, p = 0.313
	Yes	0	0.00%	1	3.57%	
Day 3	No	28	100.00%	27	96.43%	χ2 = 1.018, df = 1, p = 0.313
	Yes	0	0.00%	1	3.57%	
Day 4	No	20	100%	11	91.7%	0.1899
	Yes	0	0%	1	8.3%	
Day 5	No	17	100%	7	77.8%	0.043*
	Yes	0	0%	2	22.2%	
Day 6	Yes	1	16.7%	0	0%	-
	No	5	83.3%	0	0%	
Day 7	No	3	100%	0	0%	-

There was a significant difference in separation of tissues distribution between two groups at Day 5.

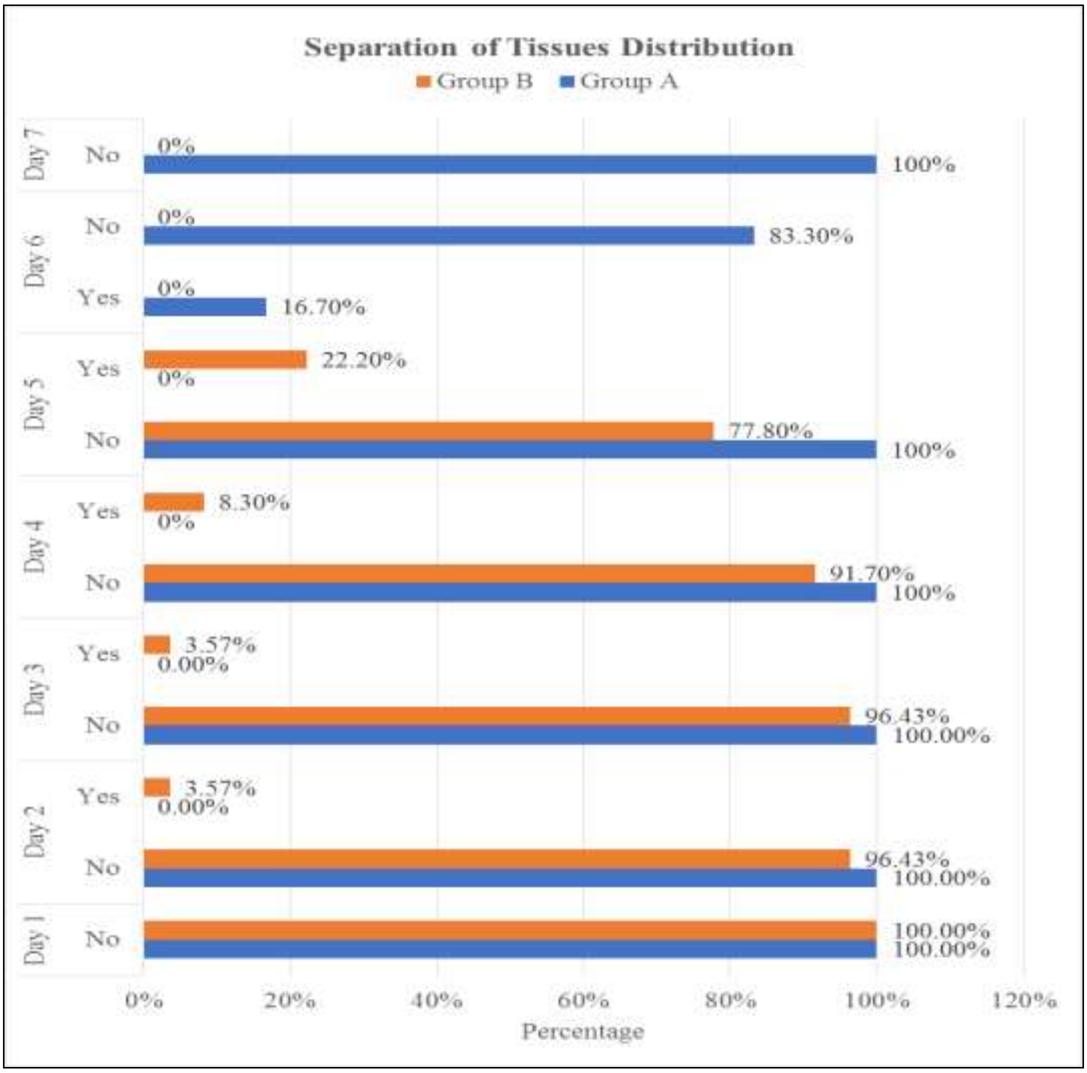

Fig 11: Column Diagram Showing Separation of Tissues Distribution between two groups

Table 13: Isolation of bacteria Distribution between two groups

Isolation of bacteria		**Group**				**P value**
		Group A		**Group B**		
		Count	**%**	**Count**	**%**	
Day 1	No organism	28	100.00%	28	100.00%	-
Day 2	No organism	28	100.00%	28	100.00%	-
Day 3	No organism	28	100.00%	28	100.00%	-
Day 4	No organism	28	100.00%	27	96.4%	0.315
	Yes	0	0.00%	1	3.6%	
Day 5	No organism	28	100.00%	27	96.4%	0.315
	Yes	0	0.00%	1	3.6%	
Day 6	No organism	28	100.00%	28	100.00%	-
Day 7	No organism	28	100.00%	28	100.00%	-

There was no significant difference in Isolation of bacteria Distribution between two groups.

Discussion

Surgical Site Infections (SSIs) are among the most common postoperative complications.

The epithelisation of the tissue is primarily based on hydration and oxygen supplementation. Maximum growth of epidermal cells occurs at 40-60% oxygen supplementation.

Collagen production and development influence the strength of the wound which is directly correlated with the partial pressure of oxygen (PO_2) of the tissue. Synthesis of collagen, cross-linking and the resulting wound strength depend on the normal function of specific enzymes. The functions of these enzymes are directly related to the amount of oxygen present, e.g. hydroxylation of proline and lysine by hydroxylase enzymes.

Achieving high oxygen levels at operated site has been proposed as a means of reducing the risk of SSI. High inspired-oxygen fractions increase tissue oxygenation [8]. Predicting SSI after surgery gives us additional intra- and postoperative risk factors such as surgery duration, treatment complexity, blood loss during surgery, administration of supplemental oxygen, and higher intraoperative lactate levels which in turn can improve the SSI prediction or augment an existing preoperative data SSI prediction [9].

Patients receiving supplemental inspired oxygen had a significant reduction in the risk of wound infection [7].

Hypoxia at the level of local wound site retards proper healing. Proper oxygenation of the tissue through microcirculation is vital for the healing process and resistance to infection [8].

Oxygen supplemented at a concentration higher than 40–50% for at least 2 h preoperatively is expected to reduce surgical site infections (SSI).

In our study we have used oronasal mask for supplementation of oxygen at the rate of 6lit/min for initial 24hr post op in the study group and no supplemental oxygen in control group, if maintaining saturation of >95% at room air.

In our study a total of 56 patients were included out of which 28 are randomised study group and 28 in control group.

There are about 15 RCT's which investigated the role of perioperative oxygen supplementation in reducing the incidence of SSI with high Fio2 i.e. 80%. A meta-analysis in these studies comparing the efficacy of high Fio2 in post op period equivocal compared to standard Fio2 (30%)

In our study we have used facemask for oxygen supplementation at the rate of 8lts/min with concentration of 80% for first 24 hours in post op period in the control group and no supplemental oxygen given if spo2 is >95% otherwise standard oxygen supplementation at the rate of 3lts/min with Fio2 30% is given.

A total 56 patients were included in the study and are allocated to control and study group by simple random sampling. The results shows no significant difference in mean age comparison (Fig1), duration of procedure (Fig2), sex distribution (Fig3) and drainage of pus (Fig5) between the two groups.

Significant difference was noted in in serous discharge (Fig8), Purulent discharge (Fig8), erythema (Fig10), separation of tissues (Fig 11) distribution between two groups from Day 1 to Day 5.

Out of 28 patients in Group A, 16 (57.14%) patients had satisfactory healing, 11 (39.29%) had disturbance of healing and 1 (3.57%) had mild wound infection. Out of 28 patients in Group B, 6 patients (21.42%) had satisfactory healing, 16 (57.14%) had disturbance of healing, 3 (10.71%) had mild wound infection, 2 (7.14%) had moderate wound infection and 1(3.57%) had severe wound infection.

Based on the observation there is statistical significance reduction in the incidence of SSI in study group.

Based on these results, SSI was seen more in Group B compared to Group A.

Mario Schietroma *et al.* 85 patients who were enrolled out of them, 43 received 30% perioperative oxygen and 42 received 80% perioperative oxygen. Supplemental 80% Fio2 during and for 6 hours after open surgery for acute sigmoid diverticulitis, reducing surgical wound infections and postoperative anastomotic dehiscence [11].

Tejaswini Vallabha *et al.* concluded that supplementation of oxygen at 60% concentration for 2 h perioperatively in clean and clean contaminated surgeries is effective in reducing postoperative surgical site infections [10].

Similarly, Motaz Qadan *et al*. analysed randomized controlled trials between 1998 and 2007 and observed infection rates of 12 % in the control group and 9% in the hyperoxic group, with a relative risk reduction of 25.3% [12].

Al Niaimi *et al*. observed that supplemental perioperative oxygenation resulted in a reduced incidence of SSI in a fixed effects model and found to be beneficial in preventing SSI in patients undergoing colorectal surgery.

Conclusions

Supplementation of oxygen at 80% concentration in first 24 hours post operative period in clean contaminated, contaminated dirty wounds is effective in reducing postoperative surgical site infections. Therefore it should be considered part of ongoing quality improvement activities related to surgical care, with few risks to the patient and little associated cost.

References

1. https://www.who.int/infection-prevention/tools/surgical/SSI-surveillance-protocol.pdf Protocol for surgical site infection surveillance with a focus on settings with limited resources
2. A systematic review of surgical infection scoring systems used in surgical patients. JBI Libr Syst Rev 2011;9(60):2627-2683.
3. Sunil V Patel, Shaun C Coughlin, Richard A Malthaner. High-concentration oxygen and surgical site infections in abdominal surgery: a meta-analysis. Can J Surg 2013;56(4):82-90.
4. Belinda De Simone Massimo Sartelli, Fausto Catena. Intraoperative surgical site infection control and prevention: a position paper and future addendum to WSES intra-abdominal infections guidelines. World Journal of Emergency 2020, 15.
5. Pascal Thibon, France Borgey, Sebastien Boutreux *et al*. Effect of Perioperative Oxygen Supplementation on 30-day Surgical Site Infection Rate in Abdominal, Gynecologic, and Breast Surgery. Anesthesiology 2012;117:504-511.
6. Kurz A, Kopyeva T, Suliman I, Podolyak A *et al*. Supplemental oxygen and surgical-site infections: analternating intervention controlled trial 1Supplemental oxygen and surgical-site infections: an alternating intervention controlled trial. A British Journal of Anaesthesia 2018;120(1):117-126.
7. Javier Belda *et al*. Supplemental Perioperative Oxygen and the Risk of Surgical Wound Infection A Randomized Controlled Trial) JAMA 2005;294:16.
8. Harsh P, Vijaya P, Hemanth K, Vijayakumar K, Surekha R. Effects of Perioperative Hyperoxygenation on Surgical Site Infection in Patients with Acute Appendicitis International Journal of Scientific Study 2018;l6(7):63-66.
9. Primoz Kocbek, Nino Fijacko, Cristina Soguero-Ruiz *et al*. Maximizing Interpretability and Cost-Effectiveness of Surgical Site Infection (SSI) Predictive Models Using Feature-Specific Regularized Logistic Regression on Preoperative Temporal Data. Computational and Mathematical Methods in Medicine 2019.
10. Tejaswini Vallabha *et al*. Rational Hyperoxia in the Perioperative Period: a Safe and Effective Tool in the Reduction of SSI. Indian J Surg 2016;78(1).
11. Mario Scheitroma *et al*. High-concentration supplemental perioperative oxygen and surgical site infection following elective colorectal surgery for rectal cancer. A prospective, randomized, double-blind, controlled, single-site trial. The American Journal of Surgery 208(5).
12. Motaz Qadan *et al*. Perioperative Supplemental Oxygen Therapy and Surgical Site Infection A Meta-analysis of Randomized Controlled Trials. Arch Surg 2009, 144.