



Impact of Pressurised pulse jet wound irrigation with Normal saline in Laparotomy wounds on Surgical site infections in comparison with standard wound irrigation techniques: A prospective trial

Authors

**Dr Ravindran Chirukandath^{1*}, Dr Sharath Kumar V², Dr Vinod .M³,
Dr Sarath Krishnan⁴, Dr Nimisha⁵, Dr Agestino⁶**

¹Additional Professor of Surgery, ²Consultant Surgeon, ³Prof and Head of the Department
⁴Associate Professor of Surgery, ⁵Assistant Professor of Surgery, ⁶Junior Resident in surgery
Department of surgery, Government Medical College, Thrissur, Kerala, India

*Corresponding Author

Dr Ravindran Chirukandath

Additional Professor of Surgery, Government Medical College, Thrissur, Kerala, India

Abstract

Surgical site infections is a dangerous condition causing a heavy burden on the patient and social health system. Such infections lengthen the hospital stay for an average of seven days and results in higher costs. Surgical site infections are among the most common hospital acquired infections comprising 14 to 16% of inpatient infections

There are various factors predisposing the infections and many of them are patient related or disease related. The Inoculation of bacteria to surgical sites forms One of the most important factors .In orders to reduce the infection One of the ways area thorough clearance of bacterial load from the wound before closure.Wound irrigation is the steady flow of a solution across an open wound surface meant to remove cellular debris and surface pathogens contained in wound exudates or residue from topically applied wound care products. The other method is Pressurized pulse irrigation of subcutaneous tissues may lower infection rates by aiding in the debridement of necrotic tissue and reducing bacterial counts.

This study compared the incidence of surgical site infections within 7days of postoperative period in laparotomy wounds irrigated using pressurized pulse jet saline irrigation (<15 psi with 2 L normal saline) and those subjected to other standard wound irrigation techniques, immediately prior to skin closure .

This study compared 128 Pulse irrigation patients and 110. Standard irrigation patients undergoing various elective n=111 and emergency procedures n=127. The overall SSI rates in 7 days in the whole group was 32/238 (13.44 %) . The SSI rates on the pulse irrigation group was 13/128 (10.16%) and Standard irrigation group was 19/110 (17.27%) and it was statically significant with a p Value of P = ..00413 showing significant reduction in the pulse group. The study also compared the SSI rates in elective and emergency procedures in both groups with significant difference in Emergency procedures. More variables are also compared between the groups and results were analyzed.

More refinement in techniques and more rationale research into the various groups of patients will be of more value in this field. This study shows an innovative simple approach can be of effectiveness in reducing the morbidity of one of the most common cause of Post of morbidity and complication in laparotomy patients

Keywords: SSI, Pulsed jet irrigation.

Introduction

Surgical Site Infections (SSIs) are infections of tissues, organs, or spaces exposed by surgeons during performance of an invasive procedure.¹ Postoperative SSIs remain a major source of illness and a less frequent cause of death in the surgical patient². These infections number approximately 500,000 per year, among an estimated 27 million surgical procedures,³ and account for approximately one quarter of the estimated two million nosocomial infections in the United States each year

Surgical Site Infection is a difficult term to define accurately because it has a wide spectrum of possible clinical features. Surgical-site infection (SSI) is defined by the Centers for Disease Control and Prevention (CDC) as a proliferation of pathogenic micro-organisms which develops in an incision site either within the skin and subcutaneous fat (superficial), muscular-fascial layers (deep), or in an organ or cavity, if opened during surgery. Since the skin is normally colonized by bacterial flora, an SSI cannot be diagnosed by the microbiological evidence alone but in conjunction with clinical signs which include redness, heat, pain and swelling, separation of the suture line (dehiscence), or the presence of an abscess in the deeper tissues. Patients may mount a systemic inflammatory response syndrome (SIRS) or in severe cases develop signs of sepsis, with an attendant increase in morbidity and mortality.

The surgical site infections are the biological summation of multiple compounding factors which includes the inoculum of bacteria introduced into the wound during the procedure, the unique virulence of contaminants, the microenvironment of each wound, and the integrity of the patients host defense mechanisms. Although an SSI rate of zero may not be achievable, continued progress in understanding the biology of infection at the surgical site and consistent applications of proven methods of prevention will allow to further reduce the frequency, cost, and morbidity associated with SSI.⁴

Surgical site infections are sub classified to Superficial Incisional SSI, Deep Incisional SSI and Organ/Space SSI . A survey sponsored by the World Health Organization demonstrated a prevalence of nosocomial infections varying from 3-21%, with wound infections accounting for 5-34% of the total.⁵ Surgical site infections (SSIs) are a major cause for post operative morbidity and they account for 14-16% of the estimated two million nosocomial infections affecting hospitalized patients in the United States.⁶ The surgical site infection rate reports by different workers have differed considerably.

A study⁷ done in India reported overall infection rate as 8.95% and number of studies carried out in India indicate an overall infection rate of 4.04 to 30% for clean surgeries and 10.06 to 45% for clean-contaminated surgeries.^{8,9,10} Collated data on the incidence of wound infections probably underestimate true incidence because most wound infections occur when the patient is discharged, and these infections may be treated in the community without hospital notification. Kirkland et al calculated a relative risk of death of 2.2 attributable to SSIs, compared to matched surgical patients without infection.¹¹

Of various methods to reduce SSIs, Wound irrigation is a promising method in which the steady flow of a solution across an open wound surface meant to remove cellular debris and surface pathogens contained in wound exudates or residue from topically applied wound care products and reduces the incidence of contamination both in elective and emergency procedures.

Pressurized pulse irrigation of subcutaneous tissues may lower infection rates by aiding in the debridement of necrotic tissue and reducing bacterial counts compared to simply pouring saline into the wound or betadine solution, thereby improving the quality of healthcare offered to the patient. However, the ideal irrigation technique and pressure required for optimal outcome are still undetermined in the literature. Pulsed irrigation is the intermittent or interrupted pressurized delivery

of an irritant, typically measured by the number of pulses per second. Original Agency for Health Care Policy and Research (AHCPR) guidelines describe safe and effective irrigation pressures as being 4-15 psi, based on a series of different studies.

This study was conducted to systematically compare the 2 methods of standard wound irrigation and pulsed jet irrigation in both elective and Emergency patients and the incidence of surgical site infection. Standard irrigation was done using a volume of around 1 Litres of normal saline irrigated as continuous flow after closure of line a Alba and jet irrigation was achieved with 30-35ml syringe with full pressure effective pressure used is between 4-15 pounds per square inch and the SSI rates and patterns of the 7 days were compared and analyzed in the two groups and different variables.

Materials and Methods

We conducted a prospective study of 238 patients who underwent elective and emergency laparotomies in department of general surgery, government medical college, Thrissur.

A prospective Cross-sectional study design was undertaken in patients undergoing laparotomy procedures where those receiving pressurized pulse irrigation are grouped as group 1 and other standard irrigation as group 2. The subjects were matched for factors affecting wound infection like age, diabetes, nutritional status, anemia as far as possible in elective and emergency patients.

The study recorded the date and time of irrigation, appearance, sloughing tissue or exudates, and Skin wound swabs taken on post-operative days if any signs of Clinical surgical site infection.

Following laparotomy and completion of procedure, Linea Alba was closed with Synthetic absorbable Loop PDS No 1 suture. All cases wound was wiped with sterile gauze. In All cases to wash the surgical wounds Normal saline Luke warm is preoperatively prepared in sterile setting. In Standard group one surgeon with new pair of gloves will irrigate the wound in sterile way

allowing the saline to run off the edge of wound and then the wound will be dried with sterile gauze and closed with Skin staplers or with 2 "ethion sutures

In Pulse jet irrigation group a one surgeon with new pair of gloves will irrigate the wound in sterile way using a 50 ml syringe and filled up to 35 ml mark (8- 15psi) wound is irrigated in the following way. The syringe will be held just above the top edge of the wound and with full pressure instill fluid into the wound continuously until the syringe is empty. It will make sure the solution flows from the clean to dirty area of the wound. Procedures are repeated the irrigation procedure until the 2 Litres of solution is administered or the solution draining from the wound is clear. (Pic 1)

Post operatively wounds were observed daily for signs of wound infection like discharge, local in duration, redness, local rise of temperature for a period of one week postoperatively by the Junior residents and the principal investigator. Post-operative wound swabs were taken, and the culture status were recorded when there is evidence of wound infection by the Units. Surgical site infection rates will be analyzed statistically in matched groups and compared. Patient confidentiality was always maintained.

Data collected from each individual were entered to excel worksheet after coding of variables & appropriate analysis was done with help of EPI-INFO and Qualitative data was analyzed with proportion, chi- square and Quantitative data was analyzed using mean, standard deviation & appropriate statistical test of significance.

Results and Analysis

We analyzed 238 cases of laparotomy wounds which were included in the study. The data collected was entered in Microsoft Excel and analyzed using SPSS version 16.

The presence of surgical site infection in pulse irrigation and standard irrigation was associated with the socio demographic variables. For this, tests of significance such as Chi square test, Fisher

exact test were used as appropriate (when more than 20% of cells have expected value more than 5, Fisher exact test was used). When the associated factor is a binominal variable, Odds Ratio (OR) was calculated with confidence interval. Significance level for p-value was set at 0.05.

The distribution of cases showed an equitable distribution and almost matched for the variables of the Age, sex. Age groups, co morbidities (Table 1). There were 111 Elective cases and 127 emergency cases spread over a variety of conditions as depicted in table (2). There was no statistical significance due to difference in age in the two groups undergoing elective and emergency surgeries

Type of anesthesia also followed a standard pattern both in elective and emergency procedures.

This study compared 128 Pulse irrigation patients and 110. Standard irrigation patients undergoing various elective n=111 and emergency procedures n=127 with wide spectrum of cases in the in both groups (Table 2)

The overall SSI rates in 7 days in the whole group was 32/238 (13.44 %). The SSI rates on the pulse irrigation group was 13/128 (10.16%) and Standard irrigation group was 19/110 (17.27%). (Table 3)

When all procedures were combined and assessed for the Surgical site infection there is a significant difference between pulse irrigation and standard irrigation procedure with a p Value of < .05 (p value= 0.004133071) suggesting that there is a significant reduction in SSI in the pulse irrigation group after all laparotomies . (Table 3).

In emergency procedures the incidence of the surgical site infection was 17.3% and there was a significant difference between the Pulse group and standard irrigation group (p Value =0.002) SSI is significantly less when pulse irrigation is employed after emergency surgeries. (Table 3b. We also analyzed the incidence of infection in elective cases in pulse irrigation and standard irrigation techniques and it's found that the

incidence of infection doesn't have any correlation between the groups (p Value = 0.668235142) (Table 3)

There was no difference in the type of surgeries, the bacterial inoculum and Type of anesthesia used for the procedures. This suggested that there is a statistically significant reduction in the pulse irrigation group in all laparotomies and Emergency procedures.

Pic 1



Table 1

	Emergency	Elective
Age		
<40	33	43
40-60	45	54
>60	33	30
Sex Ratio		
Male	74	68
Female	53	43
Age Sex Group		

Table 2 A

EMERGENCY PROCEDURES N= 127	
CONDITION	NUMBER
BLUNT TRAUMA ABDOMEN	18
EMERGENCY CHOLECYSTECTOMY	6
DU PERFORATION	32
PRE PYLORIC ULCER PERFORATION	22
APPENDICULAR PERFORATION	14
APPENDICULAR MASS	6
MEKELS DIVERTICULITIS	4
INTESTINAL OBSTRUCTION	16
COLONIC PERFORATION	4
SPLenic ABSCESS	2
PANCREATIC NECROSIS	2
COMPLICATED INTERNAL HERNIA	1

Table 2 B

ELECTIVE PROCEDURES N= 111	
CONDITION	NUMBER
FUNDOPLICATION	2
HELLERS MYOTOMY	2
CA STOMACH	24
CA PANCREAS	6
GIST	6
RT COLON CANCER	12
GB CANCER	1
CBD EXPLORATION	2
LEFT HEPATECTOMY	2
SPLENECTOMY	2
CARCINOMA RECTUM	22
SMALL BOWEL TUMOURS	4
MESCEBTRIC CYST	4
CARCIMONA OVARY	12
CA ENDOMETRIUM	8
RETROPERITONEAL TUMOUR	4
RETROEPRITONEAL ABSCESS	1

Table 3

	ssi absent	ssi present	P value
All procedures combined (3a)			
Pulse	115	13	0.004133071
Standard	91	19	
Elective Procedures (3b)			
Pulse	52	5	0.668235142
Standard	49	5	
Emergency Procedures			
Pulse	63	8	0.000299834
Standard	42	14	

Discussion

Surgical site infections cause heavy burden on the patient and social health system. Such infections lengthen bed stay for an average of seven days and results in higher costs. Surgical site infections are among the most common hospital acquired infections comprising 14 to 16% of inpatient infections and is substantiated by a survey sponsored by the World Health Organization demonstrated a prevalence of nosocomial infections varying from 3-21%, with wound infections accounting for 5-34% of the total. Surgical site infections (SSIs) are not an extinct entity; they account for 14-16% of the estimated

two million nosocomial infections affecting hospitalized patients in the United States. The surgical site infection rate reports by different workers have differed considerably.

A study done In India reported overall infection rate is 8.95% and number of studies carried out in India indicate an overall infection rate of 4.04 to 30% for clean surgeries and 10.06 to 45% for clean-contaminated surgeries.

Collated data on the incidence of wound infections probably underestimate true incidence because most wound infections occur when the patient is discharged, and these infections may be treated in the community without hospital notification. and the relative risk of death of 2.2 attributable to SSIs, compared to matched surgical patients without infection.

The study compared the incidence of surgical site infections within 7 days of postoperative period in laparotomy wounds irrigated using pressurized pulse jet saline irrigation (<15 psi with 2 L normal saline) and those subjected to other standard wound irrigation techniques, immediately prior to skin closure and to see whether a relatively simple method can reduce the incidence of surgical site infections in our part of the world.

Patients undergoing various elective n=111 and emergency procedures n=127 participated in the study. The overall SSI rates in 7 days in the whole group was 32/238 (13.45%) . The SSI rates on the pulse irrigation group was 13/128 and Standard irrigation group was 19/110(17.27%) and it was statically significant with a p Value of P = 0.00413 showing significant reduction in the pulse group Compared to standard irrigation procedure. The SSI rate reduction in emergency procedures in both groups were also analyzed and it was also statistically significant reduction in Pulse irrigation group. P < .00029. But on the contrary, there was no demonstrable statically significant change in SSI was seen in Elective group (P< .668).

We compared different variables like Sex ratio, Age factor and SSI in various s groups and no significant change was identified.

More refinement in techniques and more rationale research into the various risk groups of patients will be of more value in this field. More standardization in the sample groups will make the study more informative.

This study identifies one simple innovative technique tailored to available resources can significantly reduce the Surgical site infections in Emergency procedures of various types requiring laparotomy and also significant reduction in the overall incidence in the SSI in the various groups.

Authors do believe that more standardisation of the groups in terms of types of procedures, co morbid factors and compounding factors should be considered in further studies for gathering more information of the impact of this technique.

This study proves a dedicated standardised pulse irrigation technique is an useful and more effective method in reducing the Surgical site infection in all settings of Care.

Conclusions

The goal of the study was to assess whether pressurized pulse jet irrigation with normal saline of laparotomy wounds will reduce the incidence of postoperative SSI which is a main factor in the increasing morbidity of the patients undergoing .The study results suggests that there is decrease in the incidence of SSI in pressurized pulse jet irrigated patients compared to standard irrigation and also it decreases the postoperative stay, morbidity and cost in both emergency and Total laparotomy patients. More and more standardisation of the groups in terms of types of procedures, co morbid factors and compounding factors should be considered in further studies for gathering more information of the impact of this technique.

It has shown significant impact in reducing SSI in post laparotomy patients especially in the Emergency procedure with a simple, cost effective, uncomplicated procedure which can be done at any primary, secondary or tertiary levels without major hazardous effect to the patient

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