ORIGINAL ARTICLE

Perioperative Antibiotic use for Surgical Site Infection in penetrating Hollow Viscus Injury – A Placebo-controlled Study

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ABSTRACT

Background: Blunt penetrating hollow viscus injuries (HVIs) deserve empiric perioperative antibiotic use to stay away bacterial infection particularly surgical site infection (SSI).
Aim: To compare the efficacy of 5 days with 24 hours perioperative antibiotic use for SSIs in the HVIs.
Place and duration: Govt Allama Iqbal and Sardar Begam Teaching hospitals; January 2018 - June 2019.
Methodology: A combination of 1g sulbactam + cefoperazone and 500mg metronidazole was administered intravenously to each of the male adult (aged: 18 to 65 years) patients of penetrating HVI before (x1) and after (x3 at the interval of 8 h) of surgery. For Group A (*N* = 80), the same dosing regimen was continued for next four days i.e. total=5 days while Group B (*N* = 79) received normal saline placebo, parallelly. Subjects were examined for any SSIs in follow up session.
Results: A patient with transfusion of Packed RBCs had approximately 10-fold (95%CI:1.663 –69.847, *p* =.0001) more chance of the SSI than patients without transfusion. The SSI appeared in 13(8.2%) patients of group A and B (3 vs. 10, respectively). Antibiotic susceptible *S. aureus* was identified in the surgical wounds of 2 (66.6%) patients of Group A while antibiotic resistant *E. coli* was predominant in Group B 8(80%).
Conclusion: Perioperative antibiotic use for 5 days is better than 24 hours on HVI regarding incidence of SSI and bacterial isolates.
Keywords: Perioperative, Antibiotic, Infection, Hollow viscus injury, Placebo-controlled study.

INTRODUCTION

Exposure to microbial contamination on violence or accident-based acute penetrating hollow viscus injury makes a person prone to infection of low or high degree risk[1,2]. Prior to surgery, antibiotics are given using empirical therapy as wound defense system is unestablished. The antibiotics and dosing regimen are planned to ensure broad spectrum coverage of bacteria accompanied by minimal antibiotic resistance. Similar prophylaxis practice is also mandatory after surgical instrumentation. Sometime, the individual is free of infection but systemic inflammation response syndrome is mistaken as infection[3]. So, due care is needed in infection determination. However, loopholes in the prophylactic protocol and patient's mishandling may lead to prolong morbidity-led mortality. Here, budgetary and social issues cannot be saved on prolonged hospitalization especially in morbidity on colorectal injuries[4,5].

The penetrating HVI is usually seen in adult males on brutal interpersonal violence[6]. Professionals record clinical information including penetrating abdominal trauma index (PATI) beside examination of injured abdominal organ(s) especially of hollow viscus type under strict antiseptic scenario[7,8]. However, management of bacterial infection is the mandate of competent surgical lineup. Determination of category of infection (by site) e.g. simple surgical-site infection or complicated necrotizing fasciitis precedes microbial culturing and identification. The deep surgical-site infections e.g. purulent peritonitis needs surgery before definitive therapy while opening of closed wound is followed by definitive therapy in the case of superficial wound infection.

Like any other effect, there is a list of causes (risk factors) for the postoperative infection on penetrating HVI. The HVI-inflicting weapon i.e. firearm or stab is the first one in this connection. A study[1] also consider decrease in systolic pressure in emergency room or operation theatre as the predisposing factor. Similarly, transfusion of packed blood cells increment the hazard in the horrendous individual.

Open-accessed articles[1,3,9,10] on perioperative antibiotic prophylaxis (5 days vs. 24 hours) for infection on penetrating intrabdominal injuries including hollow viscus injuries ended with different conclusions. In addition, there was no proof of such examination at Allama Iqbal memorial teaching hospital Sialkot. To address the confusion and research gap, present study was designed with the aim "To compare the efficacy of 5 days and 24 hours perioperative antibiotic usage for SSI on HVIs". The discoveries will support both, specialists and analysts for further examinations to get some improved results.

METHODOLOGY

This prospective, randomized, placebo-controlled study was accomplished between January 2018 and June 2019 in the Department of General Surgery in Govt Allama Iqbal

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Memorial, and Sardar Begum Teaching hospitals, Sialkot, Pakistan after getting permission from the ethics committee of the study settings.

All the male patients (aged: 18 - 65 years) presented to trauma centre within 6 h of inflicted single penetrating abdominal hollow viscus injury (at least 11cm in size) were registered. Baseline information e.g. injury severity score including injury Severity Scores, Trauma Scores, and Penetrating Abdominal Trauma Index scores; hypotension and numbers of transfused units of packed red blood were recorded by trained staff.

Combination of 1g sulbactam + cefoperazone and 500mg metronidazole was administered intravenously to each of the patients not before more than one hour of the surgery. The same dose is given to each patient for 3 time (at the interval of 8h) in next 24h. Now, all those who had non-study antibiotic administration within 72 h of operation, a known terminal illness, known allergy to b-lactam antibiotics or whose next of kin did not give participation consent were excluded. The purpose sampling continued to recruit 159 patients (one half of a similar study[1]). Each of the subjects was then randomized (1:1 randomization) into one of the two (i.e. A or B) Groups. Subjects of Group A received the same thrice a day dosing regimen for next 4 more days (total = 5 days) while that of B received equivalent quantity of normal saline placebo, parallelly.

The study was discontinued or additional antibiotic treatment initiated on seeing drug reaction (adverse experience) or infection. Deep surgical site infections were surgically addressed before definitive antibiotic therapy whereas opening of closed wound followed by antibiotic therapy was practiced in case of superficial wound infection. The nosocomial infections were defined as per the CDC[11] definitions. Identification and characterization of the bacterial isolates from SSIs was commenced as per standard protocols by bacteriologists.

The continuous data was presented as Mean (±) while nominal in numbers (%). Chi-squared test was applied to see association between SSI and demographic characteristics. A value of p <.05 was taken as significant. All the statistical techniques were used in SPSS ver. 25.

RESULTS

Of 340 patients with penetrating HVI of various severity levels, 159 (46.8%; predominated by Allama Iqbal Hospital) met the qualification criteria before group allocation for perioperative use of antibiotics for SSIs. Group A (with five days') and B (with 24 Hours' antibiotic regimen) had 80 and 79 subjects, individually. However, the research team had to enroll five more members in place of three study leaving and two dead patients. Both the deaths occurred in Group B (Mortality rate =1.3%) within 24 h of operation at Allama Iqbal Hospital. The chance of treatment failure was ruled out as deaths were due to grievous traumatic injuries. Moreover, the number was lesser than expected 2.3 by TRISS methodology.

Urban inhabitants represented 60% of the populace in both the study groups of treatment. The Group A had 38 and 2% (p = .0001) from towns and villages, respectively but B had 39% from towns. However, both the study groups were almost similar in all other clinical information Table 1). The mean age of the subjects was found as 31±7.4 or 34±8 for Group A or B, respectively. Insignificant difference was seen between the two groups with respect to injury severity scores (TS, ISS, and PATI), weapons of injury (GSW and SW), prevalence of emergency room or intraoperative hypotension, and rate of perioperative transfusion (p > 0.05).

The numbers of patients in respective viscus organs was slightly higher in Group A than B (p > 0.05) except small bowel as shown in Table 2. However, frequency of small bowel injury in Group A (n=24) and B (n=30) had significant difference after chi-squared test and 2x2 cross tabulation in SPSS (p = 0.04). Moreover, almost similar numbers were found in case of combined/multiple HVIs (21 vs.18 patients). Surgical site infection appeared in total 13 patients (incidence rate = 8.2%) with ratio of 1 : 3.34 in group A and B (3 vs. 10, respectively). However, insignificant difference of infection rate was seen between the groups when infections by site including intra-abdominal abscess, purulent peritonitis, necrotizing fasciitis, or superficial wound were under observation (p > .05) (Table 3).

Table 4 shows extent of association of the surgical site infection with demographic variables. A patient with transfusion of Packed RBCs had approximately 10-fold (95%CI:1.663 – 69.847) more likelihood of the infection than patients without transfusion (p = .0001). However, none of the other factors showed association with this type of infection. The SSI appeared in 13(8.2%) patients of group A and B (3 vs. 10, respectively). Bactria *S. aureus* was identified in the surgical wounds of 2 (66.6%) patients of Group A while *E. coli* was predominant in Group B 8(80%). Moreover, all the cases were culture positive for bacterial pathogens.

Table 1 Clinical information of subjects

Variable	Group A	Group B
Age; y	31 ± 7.4	34 ± 8.1
Sex (Male); %	95	97
TS	14 ± 1	14 ± 1
ISS	16 ± 7	16 ± 9
PATI	19 ± 12	20 ± 14
%GSW	71 (n = 57)	70 (57)
%SW	29 (23)	29 (22)
ER ↓BP; %	15 (12)	14 (11)
Intra-operative ↓BP%	12 (10)	14 (11)
PRBC	6 (5)	7 (6)

TS – Trauma scores, ISS – Injury severity scores, PATI – Penetrating abdominal trauma index, GSW – Gunshot wound, SW – Stab wound, ER – Emergency room, BP – Blood pressure (systolic), and PRBC – Packed red blood cells. The continuous variables were subjected to Student's t test while discrete variables to Cochran-Mantel-Haenszel χ^2 test controlling for hospitals.

Table 2: Frequency of patients with penetrating HVI by organ

Organ	Group A (5 Days)	Group B (24 Hrs)	*p*
Stomach	8	7	1
Duodenum	17	15	0.84
Small bowel	24	30	0.04
Colon	10	09	0.95
Combined*	21	18	0.83

p-value after Cochran-Mantel-Haenszel χ^2 test. *predominantly, colon and small bowel.

Table 3 Surgical-site infections by type (*N* = 13)

Type	Group A (5 Days)	Group B (24 Hrs)	*p*
Intra-abdominal abscess	1	2	0.64
Purulent peritonitis	0	2	0.13
Superficial wound infection	2	4	0.34
Necrotizing fasciitis	0	2	0.13

Table 4 Risk factors for surgical site infection

Variable	Surgical site infection% (n)	RR	95%CI	*p*
GSW				
No	7.7 (1)	.218	.029–1.626	.11
Yes	10.4 (12)			
SW				
No	6.7 (6)	.657	.231-1.867	.42 (χ^2 test)
Yes	10.1 (7)			
ER ↓BP				
No	9.8 (11)	2.308	.532–10.014	.35
Yes	4.3 (2)			
Intra-operative ↓BP				
No	9.6 (11)	2.171	.501–9.410	.35
Yes	4.4 (2)			
PRBC				
No	2.0 (3)	10.77 7	1.663 – 69.847	.0001
Yes	90.9 (10)			

Fisher's Exact test unless until stated.

DISCUSSION

Any delay in diagnosis[12] and/or interventional approach increases the chance of morbidity and mortality in patient with HVI. So, next of kin concentrates on the concerns rather becoming part of any clinical study – a predictor for low subject eligibility rate. So, low subject eligibility rate (i.e. 46.8% of 340) can be interpreted in this perspective. Similarly, clinicians usually probe severity level of injuries, organ failure and sepsis[13] to ascertain the cause of the postoperative mortality.

Identification of most of the participants of present work (60% of total 159) as urban residents agrees to a similar published study[14] on penetrating blunt abdominal trauma. In cities, the chance of interpersonal violence is high on account of certain factors including business enmity, and political polarity. Insignificant difference in baseline information of the subjects of two groups (i.e., A and B) is just a coincidence and might be attributed to computer-generated random allocation. Like sufferer of road side accident, the patient of penetrating HVI is shifted to trauma centre by involvement of call handlers of Rescue 1122 – A public sector emergency service at Pakistan[15].

Small intestine is highly vulnerable hollow viscus organ of blunt penetrating abdominal injuries. Here, jejunum and ileum are usually affected[16]. Our finding are in accordance with this verdict as 45/179 patients were brought to hospital with injured small intestine. Moreover, multiple HVIs in 39 sufferers seems to be a big issue for the law enforcing agencies and public health sector. Similarly, diagnosis of surgical site infection in 13 patients (incidence rate 8.2%) reveals some lacunae in the surgery e.g. delayed skin closure;[17] nonadherence to treatment protocol, and development of bacterial resistance against antibiotics. However, the frequency might enhance many fold if the empiric prophylactic antibiotics did not qualify the criteria of broad range. Empiric antibiotic treatment may be followed by emergence of SSIs with higher rate; hence, adherence to antibiotic prophylaxis guidelines reduces the risk of SSI in patients undergoing trauma laparotomy[18,19]. otherwise, there SSIs adversely effects the health and economic indices of the patient[20].

Packed red blood cells (pRBCs) are supplied to the patient of penetrating HVI to restore the oxygenation of the tissues. Transfusion of contaminated or cells with the storage age of 30 days or more can result in the form of infection or sepsis[21-24]. Coincidently, predominance of E. coli followed by S. aureus is as per the patterns of isolates in a Pakistani study[25] on isolation of bacteria from surgical site wounds for antibiotic susceptibility.

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