■ *Original Article*

Preoperative prophylactic antibiotics in orthopaedic surgery: duration of antibiotic administration

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Abstract

Background: Surgical site infection is one of the most dreaded complications faced by an orthopaedic surgeon. **Objective:** To find out the effect of duration of prophylactic antibiotics on the rate of surgical site infection in clean elective orthopaedic surgeries. **Methods:** We conducted a randomized controlled trial involving 207 clean elective orthopaedic patients undergoing surgery. The patients were divided into three groups which received intravenous prophylactic antibiotics for 24 hours, 48 hours and 48 hours followed by 7 days of oral antibiotics respectively. The patients were followed up for three months. **Results:** There was no significant difference in the rate of surgical site infection among the three groups. **Conclusion:** We conclude that there is no benefit in prolonging preoperative prophylactic antibiotics beyond 24 hours.

Keywords: prophylactic antibiotics, surgical site infection.

Introduction

Surgical site infection is one of the most dreaded complications faced by an orthopaedic surgeon. In an era of evidence-based medicine, it is in the interest of the patient and the surgeon to follow practices backed by basic and clinical sciences.[1] There are multiple studies which support prophylactic antibiotic administration for 24 hours postoperatively rather than multiple days.[2-4]

There are financial implications also in reducing the duration of antibiotics to 24 hours but the concern to limit the use of perioperative antibiotics to 24 hours is not just for economic reasons. Continuing antibiotics for longer than 24 hours after wound closure may contribute to the development of antimicrobial resistance.[5-7]

In practice, many of the orthopaedic surgeons use antibiotics for more than 24 hours. So it has become absolutely necessary to validate in our conditions what the surgeons in the developed countries have been advocating. This study was performed to see if there was any difference in the rate of infection among patients who received 24 hours of IV antibiotics and those who received the same for longer duration, in our setting.

Methods

Randomized controlled trial was conducted in the Department of Orthopaedics, B.P. Koirala Institute of Health Sciences, Dharan, Nepal. The study population included a total of 240 clean elective cases operated by the authors with or without using implants in the Orthopaedic Routine Operation Theater from 1st March 2009 to 8th November 2009. Those patients

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who had earlier wounds whether healed or otherwise and those patients who had undergone earlier surgeries were excluded from the study. All types of orthopaedic surgeries generally performed in an orthopaedic operation theater like closed fracture fixation of limb and spine, soft tissue surgeries like tendon reconstruction or transfers, excision of benign tumours and hip arthroplasties were included. The records of 2008 showed that the number of cases operated in routine OT (excluding paying cases) from 1st January to 31st December was 504. Arbitrarily it was decided to take half of the cases. Two hundred and forty were considered appropriate so that it could be divided into 3 equal groups. The 240 patients were randomized into 3 groups using the random number generated by the software available at http:/www.randomization.com.

Patients belonging to Group A were administered 2 gm of injection cefazolin and 80 mg injection gentamicin within 60 minutes before incision. Postoperatively, injection cefazolin one gm and injection gentamicin 80mg was repeated eight hourly for 24 hours. It was not followed with oral antibiotics. When the duration of surgery exceeded two hours or when there was excessive bleeding, one dose of each antibiotic was repeated intraoperatively.

Patients belonging to Group B were administered the same antibiotics as in Group A but postoperatively, it was continued for 48 hours. No oral antibiotics were administered.

Group C patients were administered antibiotics as in Group B but were followed with oral cefadroxil 500mg twice daily for 7 days. This group was taken as control group as this represents how most of the orthopaedic surgeons administer perioperative antibiotics. In all pediatric cases doses were reduced.

The study was approved by the Ethical Review Board of B.P.Koirala Institute of Health Sciences. Informed consent was taken from all patients included in the study. The authors did not receive any outside funding.

The pro forma for each patient included information about age, gender, duration of surgery (incision to closure), associated medical illness, preoperative haemoglobin level, preoperative albumin level, blood loss during surgery and preoperative admission days. The patients were discharged after 48 hours of surgery having wound inspection and change of dressing. The patients were followed up after 14 days, six weeks and at three months to look for signs of surgical site infection. The study was considered completed at three months for each patient if there was no infection or whenever an evidence of infection was observed before completion of three months.

Our criteria for judging whether or not a wound infection occurred were as follows which has been modified from that of Pavel et al.[8]

1. If a wound drained purulent material irrespective of whether an organism was cultured or not it was considered infected.
2. When a wound became red, painful or tender, swollen and hot for more than 48 hours, the wound was considered infected.
3. When the patient had fever for more than 48 hours and no other cause could be traced, the wound was considered infected.
4. If the patient had a stitch abscess with a small amount of purulence directly around a suture, but without any signs of inflammation or fever, the wound was not considered infected.

Although some may argue with our criteria, we considered them to be stringent enough not to miss any wound infection.

Data were entered into Microsoft Office Excel program and analyzed using SPSS (Statistical Package for Social Sciences) version 17.0 software. Preliminary analysis was performed by calculating percentage, mean and standard deviation to get an idea about the proportion, central tendency and dispersion respectively. Chi-square and Mann-Whitney tests were applied to find the association of surgical site infection with duration of antibiotic administration after adjusting the rest of explanatory variables. A p value <0.05 was considered significant.

As part of the study, a survey was conducted to find out the current practice among orthopaedic surgeons in Nepal. Questions were asked via email regarding the choice of perioperative antibiotics used and the duration of intravenous administration and oral antibiotics.

Results

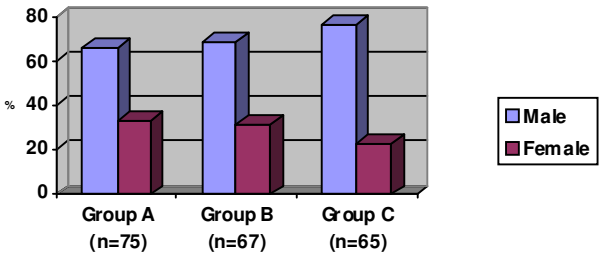
Of the 240 patients we included in the study, 33 were lost to follow up. So the pro formas of 207 patients were analyzed. There were 75 patients in Group A, 67 in group B and 65 in group C. Out of the 207 patients, 146 were males and 61 were females.

The proportion of infection among males is nearly twice as those in females. However, there is no statistical association between infection and gender (p>0.05) (Table1 and Figure 1).

Table 1: Relation of infection to gender

Gender	Infection		Total	P value
	Absent	Present		
Male	137 (93.8%)	9(6.2%)	146	
Female	59(96.7%	2(3.3%)	61	0.399

Figure 1. Sex distributin among participants in three groups



x^2=1.93, P=0.381 (Not Significant)

The variables such as age, duration of surgery, preoperative haemoglobin, blood loss during surgery, preoperative albumin level and preoperative admission days were compared among the three groups and was found to be statistically insignificant showing that randomization was successful (Table 2).The means of above variables were also compared among those who had infection and those who did not. All the variables were found to have no association with infection except the duration of surgery (Table 3). The mean duration of surgery among those who did not have infection was 82.70 minutes whereas it was 106.82 minutes in those with infection (p<0.05). The most common medical illness that we encountered was hypertension followed by diabetes mellitus. The association of presence of associated illness in the three groups were not significant (Table 4).The proportion of infection present among those with or without medical illness was almost homogenous (p>0.05) (Table 5).

Table 2: Measures of different variables in three different groups

Variables	Group A (n=75)	Group B (n=67)	Group C (n=65)	P value*
Age	39.36±21.59	34.30±21.55	34.52±19.18	0.270
Duration of surgery (min)	83.07±48.45	83.66±52.09	85.38±46.38	0.822
Preoperative Haemoglobin (gm/dl)	12.42±2.08	12.360±2.00	13.812±8.56	0.501
Blood loss (ml)	177.27±166.61	154.40±140.01	232.92±217.21	0.060
Preoperative albumin (gm/dl)	4.324±0.71	4.467±1.0327	4.31±0.769	0.796
Preoperative admission days	4.53±4.37	3.10±3.631	3.18±3.14	0.063

* Probabilities based on Kruskal Wallis test.

Table 3: Relation of age, duration of surgery, preoperative haemoglobin level, blood loss during surgery, preoperative albumin level and preoperative admission days to infection

Infection	Age	DOS (in min)	Preop. Hb level (in gm/dl)	Blood loss (in ml)	Preop. Alb. level (in gm/dl)	Preop. admission days
Infection Present						
Mean	33.64	106.82	13.091	204.55	4.582	3.55
Std. Deviation	15.468	45.071	1.9481	178.12	0.4535	2.911
Infection Absent						
Mean	36.35	82.70	12.824	186.38	4.353	3.65
Std. Deviation	21.173	48.794	5.2258	179.20	0.8592	3.871
Total						
Mean	36.20	83.99	12.838	187.34	4.365	3.65
Std. Deviation	20.888	48.803	5.1028	178.76	0.8431	3.821
P value	0.868	0.042	0.344	0.628	0.274	0.797

DOS : Duration of surgery, Preop Hb : Preoperative Haemoglobin, Preop. Alb. : Preoperative Albumin

Table 4: Associated medical illness (ASM) with infection according to the three groups

Infection	Associated medical illness	Group			Total	P Value
		A	B	C		
Presence	PRESENCE	1 (25.0%)	1 (33.3%)	0 (0.0%)	2 (18.2%)	NA*
	ABSENCE	3 (75.0%)	2 (66.7%)	4 (100.0%)	9 (81.8%)	
	Total	4 (36.36%)	3 (27.27%)	4 (36.36%)	11 (100.00%)	
Absence	PRESENCE	16 (22.5%)	9 (14.1%)	8 (13.1%)	33 (16.8%)	0.271
	ABSENCE	55 (77.5%)	55 (85.9%)	53 (86.9%)	163 (83.2%)	
	Total	71 (36.22%)	64 (32.65%)	61 (31.12%)	196 (100.00%)	

*χ^t test is not applicable

Table 5: The relation of associated medical illness to infection

Associated medical illness		Infection		Total	P value
		Present	Absent		
AMI Absent	Count	9	163	172	0.908
	% within the infected group	5.2%	94.8%	83.1%	
AMI Present	Count	2	33	35	
	% within the infected group	5.7%	94.3%	16.9%	
Total	Count	11	196	207	
	% within the infected group	100.0%	100.0%	100.7%	

AMI: associated medical illness

The percentages of infection in all groups were uniformly high. Four (5.3%) out of 75 were infected in Group A. Similarly there were three out of 67 (4.5%) in Group B and 4 out of 61(6.2%) infection in Group C. The mean percentage of infection was 5.3% (Table 6).

Table 6: The percentages of infection among the three groups

		Infection		Total	P value
		Absent	Present		
Group A	Count	71	4	75	0.912
	% within group	94.7%	5.3%	100%	
Group B	Count	64	3	67	
	% within group	95.5%	4.5%	100%	
Group C	Count	61	4	65	
	% within group	93.8%	6.2%	100%	
Total	Count	196	11	207	
	percentage	94.7	5.3	100%	

The most important question that this study sought to answer was: 'Does administering antibiotics for prolonged periods decrease the chance of surgical site infection?' Logistic regression test, after adjusting other variables performed to examine the relationship of infection to the three groups answered that there was no difference of significance in the rate of infection between any groups ($p>0.05$).

Twenty six orthopaedic surgeons responded to the survey conducted via email to find out the current practice among orthopaedic surgeons regarding antibiotic prophylaxis. None of the respondents used antibiotics for 24 hours alone. Twenty three percent of them administered IV antibiotics for 24 hours but followed with oral antibiotics for 2-14 days. Another 23% administered IV antibiotics for 48 hours, 38.5% for 72 hours and 15.5% for more than 5 or more days. All followed with oral antibiotics for 2 to 14 days.

Discussion

Postoperative infections have been shown to significantly increase morbidity, extend the patient's hospital stay; drastically increase the cost of the medical system and cause severe physical limitations that diminish the quality of life.[9] Decreasing the incidence of surgical site infection is a matter of utmost interest to both the patients and surgeons.

Literature is flooded with articles that relate surgical site infection to a variety of factors of which some are modifiable, some are not. The use of prophylactic antibiotics is one of the most important factors in decreasing infection and one that all surgeons are concerned about.

The clinical use of prophylactic antibiotics in orthopaedic surgery was not always supported. Early poorly designed studies found that perioperative use of antibiotics in clean orthopaedic cases was associated with increased infection rates.[10,11] Despite these unfavourable results, investigations continued into the use of prophylactic antibiotics in orthopaedic surgery.[6]

All orthopaedic surgeons in Nepal believe in using prophylactic antibiotics but there is discrepancy in the duration of their use. Available literature recommends the use of prophylactic antibiotics for 24 hours only and advise against using them for longer periods. Administration of prophylactic antibiotics for longer than 24 hours has not been demonstrated to be effective and may actually lead to superinfection with drug resistant organisms.[5-7] Heydemann et al.[12] in 1986 surveyed 466 procedures over a period of four years. There was no difference in the infection rate whether the antibiotics were given intraoperatively or for 48 hours, three days or seven days. Nelson et al.[13] compared one day versus seven days of preventive antibiotic therapy in orthopaedic surgery and found no significant difference in infection rates. Williams and Gustilo retrospectively compared the outcomes for 1341 patients who had received prophylaxis for three days following total joint arthroplasty with those for 450 patients who had received it for one day. Infection developed in eight (0.6%) of the 1341 patients in the first group compared with three (0.67%) of the 450 in the second group.[14] It was necessary to find out whether longer use of antibiotics decreased the incidence of infection in our setting which is less than ideal.

Factors like duration of surgery, associated medical illness, preoperative haemoglobin status, preoperative serum albumin level, amount of blood loss during surgery and preoperative admission days would be expected to influence the incidence of infection. Malnutrition is a known risk factor for deep infection after a variety of orthopaedic surgical procedures.[15,16] A serum albumin level of less than 3.5 g/dl has been associated with an increase in wound complications.[17] In our study 11% of the patients had serum albumin less than 3.5 g/dl. We found only the duration of surgery had a statistical association with the incidence of infection. Longer the duration of surgery, more was the chance of surgical site infection. Perhaps our sample size was not large enough.

The mean infection rate in our study was 5.3% which must be considered high. We do not know the infection rate of other institutions in Nepal. The infection rate in a study by Pavel et al.[8] in which the patients received cephaloridine was 2.85% and the study by Henley et al.[18] in which the patients received cefamandole was 1.6%. Postoperative infection has been estimated to occur following 1% to 2% of all total hip arthroplasties and 2% to 4% of all total knee arthroplasties in the United States.[19,20] In our study there was no statistical difference between the rate of infection among those who received 24 hours of antibiotics and those who received the same for longer durations. This shows the futility of administering antibiotics for longer than 24 hours.

The use of 24 hour antibiotics prophylaxis instead of 48 hours saves Rs 15, 00,000 per 10,000 patients

when a cheaper antibiotic like cephazolin is used and Rs 30,00,000 when an antibiotic like ceftriaxone or cefuroxime is used. When the costs of oral antibiotics are added, the saving is even more.

The survey conducted among the Nepalese orthopaedic surgeons show that there is strong reluctance to minimize the duration of IV antibiotics to 24 hours in spite of its advocacy in the literature.

Conclusion

We conclude that in clean elective orthopaedic surgeries, administering prophylactic antibiotics for more than 24 hours postoperatively provide no additional advantage.

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