Journal of Anesthesia & Clinical Research

Jisha, J Anesth Clin Res 2016, 7:4
http://dx.doi.org/10.4172/2155-6148.1000612

Research Article Open Access

Timing of Prophylactic Antibiotic Administration in Elective Surgical Patients at Jimma University Teaching Hospital: South West Ethiopia

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Received date: October 21, 2015; **Accepted date:** January 26, 2016; **Published date:** January 30, 2016

Abstract

Study objective: To evaluate the timing of prophylactic antibiotic administration in elective surgical patients, and anesthetists' opinion regarding this issue.

Design: Prospective, facility based cross-sectional study was employed.

Setting: Jimma university teaching hospital (JUTH)

Patient: Elective surgical patients and anesthesia professional of the hospital.

Measurement: Data were collected prospectively from all elective surgical patients (except emergency, obstetric cases) and interred in predesigned forms as per existing protocol in JUTH from February 01 to March 30, 2014. The time of antibiotic prophylactic administration in respect to incision time was analyzed and descriptive result was presented as percentages of total responses.

Main results: Prophylactic antibiotics was given before skin incision for 107 (79.9%) patients and 27 (20.1%) after skin incision. However; only 75 (56%) patients were get administered within proper time (60minutes) and the mean time of preoperative administration was 66+24 minutes. Prophylactic antibiotic medication was continued for >24 hours in 95% cases and re-dosing were not given for six surgical procedures which lasted >3 hours.

Out of 26, only 71% anesthetists could mention the recommended time of antibiotic prophylaxis administration. About 21(80.8%) of anesthetists agreed that its surgeon's responsibility for preoperative antibiotic selection and shared with nurses for preoperative administration. Anesthetists assume that they are responsible for confirmation of pre-incision administration and repeat administration during prolonged surgery. They indicated training was inadequate and deemed necessary in 77% of participants.

Conclusion: The timing of prophylactic antibiotic administration was below the standard of practice. Hospital administration and infection control officer should work to improve compliance in accordance with published evidence-based guidelines.

Keywords: Administration; Anesthetist; Prophylactic antibiotics; Timing; Training; JUTH

Introduction

Surgical site infection continue to be a major public health problem that imposes enormous impacts both on patients' life and substantially to the financial cost of patient care. Surgical site infection is the second most common hospital associated infections accounting 14-16% of all hospitalized patients; and 38% among that of surgical patients [1-3].

In developing countries, especially in sub-Saharan Africa this figure is twice or three times higher than developed countries [4].

Although information was limited, the overall SSI rate in Ethiopia was reported to be in a range of 14.8-75% in general surgical wards at different teaching hospitals [4-7].

Almost all surgical sites are contaminated with bacteria to some extent though optimal care was taken to maintain asepsis and causing surgical site infection. Although there are various ways of preventing SSIs, administering antibiotic prophylaxis at the appropriate time, (60-30 minute before surgery) contributes a lot than other methods [8].

Different researcher showed that the standard surgical precaution; proper prophylactic antibiotics administration significantly minimizes the incidence of SSI by 40-60%. Different Guideline and researcher has been promoted on three areas; proper timing of administration within 60 minutes prior skin incision, correct selection of antibiotics and correct duration of postoperative administration [9,10].

It has been documented that untimely use or omission of single dose perioperative antibiotic prophylaxis has been associated with increased incidence and severity of postoperative SSIs [11].

The selection of antibiotic should be taken into consideration for its safety, cost-effectiveness, and active against commonly encountered pathogens based on the type of procedures which will be guided by local resistance patterns [12-14]. Usually first and second-generation cephalosporins are appropriate prophylaxis for most procedures, although coverage of anaerobes is necessary for colon and some gynecologic surgery [12].

It is generally agreed that all clean wound do not need but for all procedures of clean-contaminated prophylactic antibiotics should be administered before skin incision (within 60 minutes). However, contaminated or dirty wounds are already infected and need therapeutic pre-operative antibiotics not for prophylactic purposes [12,14,15]

The intention of perioperative prophylaxis is to attain therapeutic levels of antibiotic agents in the tissues at the time of microbial contamination. Therefore timing of administration is critical in order to ensure effective drug levels, as both early and late administration are associated with increased infection rates [12,17].

A single dose of prophylactic antibiotic given prior to incision is sufficient for most surgical procedures. However, re-dosing should be considered when there is extensive hemorrhage and surgery lasting longer than 3 hours. In patients antimicrobial prophylaxis is planned to be continued postoperatively, the duration is recommended to be less than 24 hours [12,17].

Despite such timing and appropriate selection of prophylactic antibiotic administration is important for a patient safety and outcome [11], it is continuously appended and challenging as showed in many study results [18,19]. A Health Care Quality Improvement Project of New York State showed from retrospective review of 2651 patients; about 27%-54% of all patients did not receive antimicrobial prophylaxis in a timely fashion [18]. Although it's inevitably advantageous in outcome of surgical patients no attempts were made before to explore the extent of proper timing of prophylactic administration in our hospital.

As the existing trend in JUTH a list of scheduled patients posted a day before surgery on major theatre and surgical ward's board. Preoperative anesthetic evaluations performed a day before surgery by anesthetists for verification of fitness of patients for anesthesia and get prepared on each side by surgeon, anesthetists and nurses. Every medication (including antibiotics) given on the early morning usually at 6:00 am on the day of surgery if indicated; then the ward nurse took patients to operation theatre (waiting corridor) turn by turn according to list on schedule. The expected time of skin incision for the first patient is at 8:00 am for all elective cases.

Therefore this survey aimed to assess time of initial dose, re-dosing time and duration of administration in elective surgical patients. Also the opinion of anesthesia professional's regarding perioperative antibiotics administration and their role was explored.

Methods and Materials

A hospital based prospective study was conducted from February 01 to March 30, 2014 at Jimma University Teaching Hospital (JUTH) in Jimma, located 346 km away from Addis Ababa to South West Ethiopia. The hospital provides a range of health care services with a multidisciplinary team of diverse professionals; and capacity of 450 beds (from these 125 surgical beds) through its 9 medical and other clinical and diagnostic departments for approximately 15,000 inpatients and 160,000 outpatients each year and a total of more than 1448 staffs. The major departments includes: the Pediatrics, Surgery, Gynecology and Obstetrics, Internal Medicine, Ophthalmology, Dentistry, Psychiatry. More than 8000 patients get admitted in dentistry, surgical and gynecology wards per year and on average seven major operations would performed per day.

Operation room (OR) unit is one of the service units of JUTH. We have five operation theatres; of which three major tables shared in common to all departments; but ophthalmic and maternity (for caesarean section surgeries) have isolated theatre each. In the hospital different surgery were performed such as orthopedic surgery, hysterectomy, thyroidectomy, mastectomy, colostomy, herniorraphy, hemoriedectomy, laparatomy, prostatectomy and etc.

We observed 168 cases of elective major surgery who received prophylactic antibiotics as per existing practice in the hospital to determine the timing of prophylactic antibiotics administration relative to skin incision time. Pre-designed data sheet was kept in each operation theatre to be filled in by each respective anesthetists by reviewing patients' card or if any medication in the theatre. The form focused on the preoperative patient character; surgical type and procedure; time of induction, antibiotic administration drug type, dose and time, incision time, re-dosing time and duration of surgery were recorded. Those patients were followed every day post operatively until the prophylactic antibiotic administration stopped. Additional questionnaire focusing on anesthetist's opinion regarding the responsibility of selection, confirmation and administration of prophylactic antibiotics and adequacy/need of training were administered to all anesthetists of JUTH.

All elective surgery scheduled that has been administered prophylactic antibiotics was included after verbal consent obtained. Emergency surgery and obstetric cases were excluded from the study because of the physiologic difference and time constraint. Patients who have been on antibiotic treatment for any reason and not cooperated were also excluded.

Timing of administration was analyzed as in intervals before and after incision. It was considered as early preoperative administration if given before 1 hr before skin incision, preoperative if within 1hr before skin incision, perioperative if within 3hrs after skin incision and postoperative if after 3 hrs after skin incision.

After the data entered to computer; analyzed using SPSS version16 and presented as percentages of total observation and responses.

Ethical Clearance

Studies were conducted after ethical approval letter obtained from the Jimma university ethical review committee and official permission confirmed from hospital administration. All participants were asked for volunteer participation in study. Verbal consent was obtained from each participant; as this was an observational study of existing practice in the hospital.

Result

Timing of prophylactic antibiotics administration

A total of 230 patients have been underwent elective surgery during study period. Among this antibiotics were administered for 168 (73%) patients. From these 34 patients were on antibiotic treatment because

they have developed infection preoperatively and excluded from study. Therefore only 134 (58 male and 76 female) patients who have given antibiotics for prophylactic purpose were included in the study. Half (49.3%) of study participants were classified in the first category of American Society of Anesthesiology (ASA I). The age of the study subjects ranges from 2½ to 75 years, with the majority aged between 41-50years. Ninety eight (73.1%) patients were from rural area and 50.7 %(68) of them did not attend formal education (Table 1).

		Sex		Total	Percentage
		Female(N)	Male (N)	(N=134)	
Age	<10 years	5	12	17	12.7
	11-20years	7	5	12	9
	21-30years	9	10	19	14.2
	31-40years	10	6	16	11.9
	41-50years	25	7	32	23.9
	51-60years	15	15	30	22.4
	>60 years	5	3	8	6
ASA class	I	41	25	66	49.3
	II	27	30	57	42.5
	III	8	3	11	8.2
Educational Status	Illiterate	37	31	68	50.7
	Literate	39	27	66	49.3
Residency	Rural	55	43	98	73.1
	Urban	21	15	36	26.9

Table 1: Preoperative characteristics of elective surgical patient; JUTH, 2014.

The study results showed that in 79.9% (46 male and 61 female) of patient prophylactic antibiotics administration was before skin incision. But only 75 (56%) and five (3.7%) patients have given within 60 minutes, and between 60 and 120 minutes respectively. Mean time of preoperative prophylactic antibiotics administration was 1.7 ± 0.8 hours. However, in 20.1% (27) patients it was administered after skin incision; of which five (3.7%) patients given within 3 hours and 22 (16.4%) patients have took 3 hours later after skin incision. The study revealed almost in all patients PA medication was continued for more than 24hrs and preponderance up to 5 days. Even though large number (>56%) of surgical procedure lasted more than two hours with mean duration of 2.1+0.8 (range from 20 to 270 minutes); re-dosing was not considered for any operations (six cases) lasted more than three hours (Table 2).

Variable	Perioperative Character	Female	Male	Total	Percentage
Timing of administration (minutes)	Before skin incision between				
	0-30	17	10	27	20.1
	30-60	23	25	48	35.8
	60-120	4	1	5	3.7
	120-180	16	8	24	17.9
	before 180	1	2	3	2.2
	After skin incision between				
	0-30	1	0	1	0.7
	30-60	1	2	3	2.2
	60-180	0	1	1	0.7
	180-240	8	7	15	11.2
	later than 240	5	2	7	5.2
Duration of surgery (hour)	<2	26	27	53	39.6
	2-3	49	26	75	56
	>3	1	5	6	4.5
Surgical type	Orthopedic surgery	14	25	39	29.1
	Gastrointestinal surgery	21	15	36	26.9
	Gynecologic surgery	23	0	23	17.2
	Urologic surgery	0	11	11	8.2
	Maxillofacial surgery	1	2	3	2.2
	Others*	17	5	22	16.4
Duration of prophylaxis administration (day)	One (24hours)	4	3	7	5.2
	Two (48hours)	5	10	15	11.2
	Three (72hours)	19	18	37	27.6
	Four	12	9	21	15.7
	Five	33	11	41	30.6
	Week	3	7	10	5.5
Timing of administration in intervals (hours)	Early preoperative	21	11	32	23.9
	Preoperative	40	35	75	56
	Perioperative	2	3	5	3.7
	Postoperative	13	9	22	16.4
	Re-dosing	0	0	0	0

*thyroidectomy, breast surgery, tissue excision

Table 2: Perioperative characteristics of surgical patients who have taken prophylactic antibiotic in JUTH; 2014.

The most procedure that has been performed during study period was open reduction and internal fixation17 (12.7%) followed by external fixation, open cholecystectomy and hysterectomy 14 (10.4%) each; bowel resection 11 (8.2%), breast surgery 10 (7.5%); herniorhaphy and laparotomy (ovarian tumor) nine (6.7%) each; thyroidectomy and prostatectomy eight (6%) each; debridement five (3.7%); amputation and tissue excision (tissue sarcoma) three (2.2%) each; mandibular correction, uretroplasty and gastroduodinal surgery two (1.5%) each; and mandibulectomy one (0.7%) each (Table 3).

Surgical type	Surgical procedure	Sex of patients		Total N=134	percentage
		Female	Male		
orthopedic surgery	ORIF	5	12	17	12.7
	Amputation	1	2	3	2.2
	Debridement	1	4	5	3.7
	External fixation	7	7	14	10.4
Gastrointestinal surgery	Hernioraphy	5	4	9	6.7
	Open cholecystectomy	14	0	14	10.4
	Surgery for intestinal obstruction	1	10	11	8.2
	Gastroduodnal surgery	1	1	2	1.5
Gynecologic surgery	Hysterectomy	14	-	14	10.4
	Laparotomy (ovarian tumor)	9	-	9	6.7
Urologic surgery	Prostatectomy (BPH)	-	8	8	6
	Uretroplasty (uriteral stricture)	-	3	3	2.2
Maxillofacial surgery	Mandibulectomy	1	0	1	0.7
	Mandibular correction	0	2	2	1.5
Others	Mastectomy (breast mass)	10	0	10	7.5
	Tissue excision (tissue sarcoma)	2	1	3	2.2
	Thyroidectomy	5	4	9	6.7

Table 3: Surgical type and procedures who have taken prophylactic antibiotics in JUTH; 2014.

Six different combinations of antimicrobial drugs were used for prophylaxis. The most frequently (51%) prescribed classes of antibiotics were cephalosporins (ceftriaxone and cefazolin) followed by penicillin 32% (amoxicillin 500 mg) and chloramphenicol (CAF) 500 mg. Fifty five percent of (74) patients received a single drug (ceftriaxone 1g) for prophylaxis while 43 patients (32.1%) received two drugs (ceftriaxone and gentamycine). Ten patients (7.5%) received three drugs (ceftriaxone, ampicillin and gentamicin) and seven received four drugs (cefotaxime, metronidazole, CAF & gentamicin) for prophylaxis.

Anesthetists' opinion and their role in the timing of prophylactic antibiotic administration

A total of 31 questionnaires were administered to anesthesia team of JUTH with response rate of 83.9% (4 female and 22 male). Most (84.6%) of participants have been provided anesthesia services for more than 3 years and 38.7% (12) them were senior Master degree holder. The participants' age ranges from 26-56 years (mean=31+1.2) with a mean experience year of 6+0.9 years (Table 4). Although they believe that prophylaxis should be administered preoperatively none of them mentioned the recommended time for prophylaxis. Also only 25.8% (8) of them were knows for which type of surgical wounds prophylactic antibiotic are indicated.

		Female	Male	
Age (year)	<30	2	10	12 (38.7)
	30-40	2	9	11 (35.5)
	41-50	0	2	2 (6.5)
	>50	0	1	1 (3.2)
qualification level	Diploma	0	2	2 (6.5)
	BSc degree	2	7	9 (29)
	MSc degree/ above	1	11	12 (38.7)
	Resident	1	2	3 (9.7)
Year of experience	<3 year	2	4	4 (15.4)
	3-5 yrs	5	13	12 (46.2)
	5-10 yrs	3	1	8 (30.8)
	>10 yrs	1	2	2 (7.7)

Table 4: Sociodemography of anesthetists who have been participated in study; JUTH, 2014.

	Sex of participants	Total N (%)

All of them do not have information when re-dosing of prophylactic antibiotic should be considered. Majority 64.5% (20) of anesthetists agreed that they are responsible for the confirmation of PA administration. However; only 9.7% (3) anesthetists were noticed that they have been checking for every patient. They consider that it's the responsibility of surgeon for the selection and nurses for administration of prophylactic antibiotics. In surgical procedures lasting more than 3 hrs, they indicate that anesthetist and surgeon should be responsible for intraoperative re-dosing (Table 5).

	Responsible professionals				
Activities	**Surgeon n (%)**	**Ward nurse n (%)**	**OR nurse n (%)**	**Anesthetists n (%)**	**Total n (100%)**
Selection	21(80.8%)	2(7.7%)	1(3.8%)	2(4.35%)	26
Confirmation of administration	6(23.1%)	2(7.7%)	4(15.4%)	14(53.8%)	26
Timing of administration	10(38.5%)	9(34.6%)	3(11.5%)	4(15.4%)	26

Table 5: The anesthetists' response regarding the responsibility of selection, confirmation and timing of prophylactic antibiotics administration; JUTH, 2014.

Eighteen anesthetists were feeling they are not trained adequately and it seems additional training is compulsory in 67.7% of them (Figure 1).

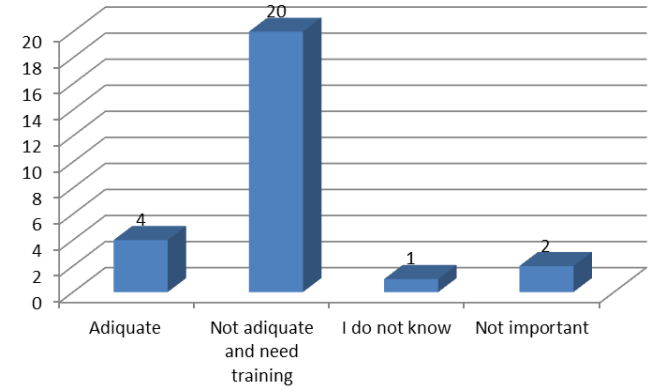

Figure 1: The anesthetists' response regarding the adequacy of training on prophylactic antibiotic therapy during pre-services training; JUTH, 2014.

Discussion

Surgical site infections (SSIs) continued causing significant morbidity, mortality and add to the cost of patient care as reports shows from different researchers [11]. Aseptic techniques alone do not eliminate bacteria, and Staphylococci aurous are often found at surgical sites. To overcome this catastrophic problem antimicrobial treatment begun prior to contamination is called antibiotic prophylaxis (AP) which is an important adjunct to control bacterial growth and significantly lower the incidence of SSIs [20].

Orthopedic (29.1%) and abdominal (22.4%) surgery was the most frequently performed surgery type and also majority of them among others took prophylaxis within the first hour.

From a total of 230 surgical cases that has been underwent elective surgery, prophylaxis was given for 73% (168 cases). Out of 168, 34 (20.2%) were for treatment purpose and 134 (79.8%) prophylactic purposes. The age of study participants (patients) ranges from 2½ to 75 years with majority (23.9) in 41 – 50years. More than half (56.7%) of them were females. This figure goes in line with the study done in Iraq [21]. Comparable figure were obtained by other researchers [22]. Among 134, in 79.9% (107) and 27 (20.1) patients the administered was before and after skin incision respectively. However; only 75 (56%) patients were get administered within 60 minutes before skin incision, (%) within 1hours before skin incision, (%) within 3 hours after skin incision and (%) after 3 hours after skin incision. Similar finding was obtained in other study India [23], Utah (USA) [20], Iraq [21]. However, it is better than that of Shah JN et al. in Nepal [22,24].

Different guideline recommends that prophylactic antibiotics are more effective if administered as close as to skin incision time; especially with in 60minutes before skin incision [18]. We found 17.9% were administered 2 hours earlier before skin incision. Therefore, it needs an improvement of adherence to prophylactic antibiotic medication guide line in our hospital [25]. In other studies better compliance were observed [26].

Though published guide lines promote to end prophylactic administration within 24 hrs [8,27,28]. But in ours we found for more than half (50.7%) the administration continued for up to five days. In different studies comparable results were reported [22,29]. Different researchers identified prolonged use of antimicrobials may contribute to bacterial resistance; the guidelines recommend that prophylaxis better end within 24 hours of surgery except in cardiothoracic surgery up to 72 hours. The problem of adherence to guideline in prophylactic administration was also identified by study done in Athens, Greece [30].

Though different guidelines recommend single drugs with extended spectrum except some procedures like colorectal surgery [31-34]; this study revealed in more than 44% study participants, in which combinations of antimicrobials were used. However; in our study abdominal surgery represents only 26.9% of study participants [35].

From 31, 26 anesthetists were responded. Out of 26, 12 were master's degree holder and have been served for more than three years. Though they feel responsible for confirmation of administration, only two anesthetists indicated that they check for every patient whether prophylaxis was administered. Only two out of 26 anesthetists mention the proper timing of prophylaxis (within 1 hour prior skin incision).

Also we noticed majority were not felt that they have adequate knowledge regarding the selection, indication, and guidelines of prophylactic antibiotics administration. But different studies showed involvement of anesthesia staffs improve the compliance on timing of prophylaxis administration [24,32,36]. Twenty (64.5%) of anesthetists agreed that they are responsible for the confirmation of PA administration and re-dosing. However; only 9.7% (3) anesthetists were noticed that they have been checking for every patient. They consider that it's the responsibility of surgeon for the selection and nurses for administration of prophylactic antibiotics [37].

Conclusion

To my knowledge, a reliable method to ensure compliance with the appropriate timing of prophylactic antibiotics did not exist in this hospital prior to this study.

High rate of passivity with proper timing of prophylactic antibiotic administration in elective surgical patients was observed during the study period. Physician, Anesthetists and nursing management, and hospital infection control office had to work for improvement of current practice to the standard of prophylactic antibiotic administration. Continues (refresher) training should be provided for staffs every year. All operating room personnel, including the surgeons, anesthetists, and nursing staff, were committed to the concept that patients should receive antibiotics in a timely manner.

The limitations to this study include the non-response and the convenient sampling used. These preclude generalizations for a nationwide practice.

Conflict of Interest

The author declares that there is no any interest conflict.

Acknowledgement

Author would like to thank the hospital administration offices and participant (patients) for their co-operation. Author's gratitude also extends to anesthesia team for their help in completing the form and nurses who helped by delivering information regarding administration of prophylactic antibiotics.

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