ORIGINAL ARTICLE

Pre-operative antibiotic use reduces surgical site infection

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Abstract

Objective: To assess the efficacy of World Health Organisation Surgical Safety Checklist as a simple, reliable and effective tool to ensure appropriate administration of intravenous antibiotics.

Methods: The prospective interventional study was conducted in three phases at Mayo Hospital, Lahore, from May 2011 to January 2012. The first phase comprised baseline data collection, followed by implementation of World Health Organisation Surgical Safety Checklist, and finally post-implementation data collection. The duration of each phase was 3 months. Primary end points were discharge from hospital, 30 days or death of the patient.

Results: Of the 613 patients in the study, 303(49.4%) were in the pre-implementation phase and 310(50.5%) in post-implementation phase. Adherence of optimal administration of antibiotic increased from 114(37.6%) to 282(91%) ($p<0.001$). The rate of post-operative infection fell from 99(32.7%) to 47(15.2%) ($p<0.001$). Mean hospital stay was reduced from 7.8±5.7 days to 6.5±5.6 days ($p<0.001$).

Conclusion: Appropriate and timely administration of antibiotic reduced surgical site infection by more than half. Hospital stay was shortened by 1.3 days on average which results in considerable reduction in morbidity, mortality and costs.

Keywords: World Health Organisation, intravenous, antibiotic. (JPMA 65: 733; 2015)

Introduction

World Health Organisation (WHO) launched 'safe surgery saves life' programme in 2008, which included a WHO Surgical Safety Checklist that consists of a series of checks that occur before the delivery of anaesthesia, before making the first incision and before the patient leaves the operating room. There is evidence that use of checklist can decrease rate of surgical complications and catheter-related blood stream infections.[1]

Hospitals are considered to be safe, error-free places but adverse events do occur in hospitals and almost two-third of these events are associated with surgical care.[2] Data on surgical safety suggests that more than half of all surgical complications can be prevented.[3,4] Several protocols are proposed to improve patient safety and post-operative outcome.[5-7] A surgical safety checklist was introduced to reduce postoperative morbidity and mortality in surgical patients.[8] Use of WHO checklist was associated with reduction in postoperative infection rate from 6.2 to 3.4%.[1]

Surgical site infection (SSI) is a common problem with a global rate reaching up to 18%.[9] Medication errors are the most frequent and preventable type of errors.[10] Prevention of postoperative infection begins with chemoprophylaxis in preoperative period. Antibiotic prophylaxis for specific 'clean' (those that involved placement of prosthetic material or those for which an infection would be catastrophic) or 'clean-contaminated' (those that involve entry into a hollow viscus under controlled conditions and without unusual contamination) is well established.[11] Use of antibiotics in 'contaminated' or 'dirty' procedures is considered therapy than prophylaxis. For optimal results antibiotic therapy should be administered within 60 minutes before making the first incision (Table-1).[12]

All surgical wounds are at a risk of bacterial contamination as pathogenic organism can enter primarily through the incision or from haematogenous dissemination.[13] There are three different types of SSIs defined by the Centre for Disease Control and Prevention (CDC).[12]

The current study hypothesised that implementation of the checklist will ensure proper timing of antibiotic administration and reduce SSIs.

Subjects and Methods

The prospective interventional study was conducted in three phases at Mayo Hospital, Lahore, from May 2011 to January 2012. The first phase comprised baseline data collection, followed by implementation of WHO Surgical Safety Checklist, and finally post-implementation data collection. The duration of each phase was 3 months.

Patients who were at least 12 years of age and were undergoing non-cardiac, non-obstetric surgeries were included in the study. Patients who underwent emergency surgical procedure, discharged without any surgical intervention, and patients who were discharged within 24 hours were excluded. Ethical approval was obtained from the Ethical Review Committee of

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King Edward Medical University, Lahore, which waived the requirement for written informed consent form patients.

The checklist is divided in different parts that corresponds to the stages of care in the surgical pathway (preoperative, operative, recovery or intensive care and postoperative), and it is multidisciplinary — the ward doctor, nurse, surgeon, anaesthesiologist and operating assistant are all responsible for completion of parts of the checklist. Items on the checklist include an accounting of all necessary equipment and materials, timely administration of antibiotic, the marking of the patient's operative site, the hand-off of postoperative instructions and the provision of medication prescription to the patient at discharge, among other things.

Complications were documented in all patients who underwent elective general surgery and were discharged during the study period. After the implementation of the checklist during a three-month period, a post-implementation review of the checklist was conducted for the following three months.

Data on demographics, co-morbid factors, length of stay, number and types of surgical procedures was collected from hospital records and patient files. Outcome data was collected from patient examination and patient files. SSIs were diagnosed using CDC criteria.[12] Data collectors followed patients postoperatively until discharge, 30 days or death whichever occurred first. Statistical analysis was done using SPSS 17. Chi-Square test was applied as a test of significance. Multiple regression analysis was conducted to examine relationship between hospital stay, antibiotic administration and wound outcome.

Results

Of the 613 patients in the study, 303(49.4%) were in the

Table-1: Wound Classification.

Class I/Clean: An uninfected operative wound in which no inflammation is encountered and the respiratory, alimentary, genital, or uninfected urinary tract is not entered. In addition, clean wounds are primarily closed and, if necessary, drained with closed drainage. Operative incisional wounds that follow non-penetrating (blunt) trauma should be included in this category if they meet the criteria.

Class II/Clean-Contaminated: An operative wound in which the respiratory, alimentary, genital, or urinary tracts are entered under controlled conditions and without unusual contamination. Specifically, operations involving the biliary tract, appendix, vagina, and oropharynx are included in this category, provided no evidence of infection or major break in technique is encountered.

Class III/Contaminated: Open, fresh, accidental wounds. In addition, operations with major breaks in sterile technique (eg, open cardiac massage) or gross spillage from the gastrointestinal tract, and incisions in which acute, non-purulent inflammation is encountered are included in this category.

Class IV/Dirty-Infected: Old traumatic wounds with retained devitalized tissue and those that involve existing clinical infection or perforated viscera. This definition suggests that the organisms causing postoperative infection were present in the operative field before the operation.

Mangram et al(12).

Table-2: Centre for Disease Control and Prevention Surgical Site Infection (SSI) Classification System.

Superficial Incisional SSI

Infection occurs within 30 days after the operation and infection involves only skin or subcutaneous tissue of the incision and at least one of the following:

1. Purulent drainage, with or without laboratory confirmation, from the superficial incision.
2. Organisms isolated from an aseptically obtained culture of fluid or tissue from the superficial incision.
3. At least one of the following signs or symptoms of infection: pain or tenderness, localized swelling, redness, or heat and superficial incision is deliberately opened by surgeon, unless incision is culture-negative.
4. Diagnosis of superficial incisional SSI by the surgeon or attending physician.

Do not report the following conditions as SSI:

1. Stitch abscess (minimal inflammation and discharge confined to the points of suture penetration).
2. Infection of an episiotomy or newborn circumcision site.
3. Infected burn wound.
4. Incisional SSI that extends into the fascial and muscle layers (see deep incisional SSI).

Note: Specific criteria are used for identifying infected episiotomy and circumcision sites and burn wounds.

Deep Incisional SSI

Infection occurs within 30 days after the operation if no implant* is left in place or within 1 year if implant is in place and the infection appears to be related to the operation and infection involves deep soft tissues (e.g., fascial and muscle layers) of the incision

and at least one of the following:

1. Purulent drainage from the deep incision but not from the organ/space component of the surgical site.
2. A deep incision spontaneously dehisces or is deliberately opened by a surgeon when the patient has at least one of the following signs or symptoms: fever (38°C), localized pain, or tenderness, unless site is culture-negative.
3. An abscess or other evidence of infection involving the deep incision is found on direct examination, during reoperation, or by histopathologic or radiologic examination.
4. Diagnosis of a deep incisional SSI by a surgeon or attending physician.

Notes:

1. Report infection that involves both superficial and deep incision sites as deep incisional SSI.
2. Report an organ/space SSI that drains through the incision as a deep incisional SSI.

Organ/Space SSI

Infection occurs within 30 days after the operation if no implant* is left in place or within 1 year if implant is in place and the infection appears to be related to the operation and infection involves any part of the anatomy (e.g., organs or spaces), other than the incision, which was opened or manipulated during an operation and at least one of the following:

1. Purulent drainage from a drain that is placed through a stab wound into the organ/space.
2. Organisms isolated from an aseptically obtained culture or fluid or tissue in the organ/space.
3. An abscess or other evidence of infection involving the organ/space that is found on direct examination, during reoperation, or by histopathologic or radiologic examination.
4. Diagnosis of an organ/space SSI by a surgeon or attending physician.

Mangram et al.[12]

Table-3: Patient Characteristics.

		Pre-checklist		Post-checklist	
Mean Age (years)		34.99±14.52		38.79±1567	
Gender	Male	162	54%	152	49.0%
	Female	141	46%	158	51.0%

Table-4: Types of surgery.

System/organ	Pre-intervention		Post-intervention	
	n	Percentage	n	Percentage
Gastrointestinal	137	45.2	125	40.3
Hepatobiliary	47	15.5	57	18.4
Gynaecological	43	14.2	50	16.1
Urological	37	12.2	43	13.9
Breast	23	7.6	23	7.4
Skin & Subcutaneous	16	5.3	12	3.9
Total	303	100	310	100

Table-5: Safety protocols.

Safety Protocol	Pre-intervention (n=303)		Post-intervention (n=310)		P value
	Number	Percentage	Number	Percentage	
Use of sterile instruments	188	62	310	100	<0.001
Administration of appropriate antibiotics	114	37.6	282	91	<0.001
Confirmation of patient identity	214	70.6	285	91.9	<0.001
Pre-operative instrument, sponge and needle count	196	64.7	261	84.2	<0.001
Post-operative items count	188	62	260	84	<0.001

pre-implementation phase and 310(50.5%) in post-implementation phase. There were 314(51.2%) male patients (Table-3). Types of surgery were also noted (Table-4). Adherence of optimal administration of antibiotic increased from 114(37.6%) to 282(91%) ($p<0.001$) (Table-5). Post-implementation wound infection fell from 99(32.7%) at baseline to 47(15.2%) ($p<0.001$) (Table-6).

Table-6: Wound outcome.

Wound condition	Pre-intervention (n=303)		Post-intervention (n=310)	
	n	Percentage	n	Percentage
Good healing	204	67.3	263	84.8
Superficial incision SSI	52	17.2	36	11.6
Deep incision SSI	24	7.9	9	2.7
Organ or space SSI	11	3.6	1	0.3
Wound Disruption	12	4	2	0.6

SSI: Surgical site infection.

Table-7: Hospital stay.

Duration of Stay (Days)	Pre-intervention (n=303)		Post-intervention (n=310)	
	n	Percentage	n	Percentage
1-3	26	8.6	109	35.2
4-5	147	48.5	97	31.3
6-10	69	22.8	52	16.8
11-15	23	7.6	27	8.7
16-20	24	7.9	10	3.2
More than 20	14	4.6	15	4.8

Multiple regression was conducted to examine relationship of hospital stay with appropriate antibiotic administration and wound outcome. The overall model explained 9.2% variance in productivity ($p<0.000$). An inspection of individual factor revealed timing of antibiotic administration (Beta=0.25; $p<0.001$) and wound outcome (Beta=0.19; $p<0.001$) are significant predictors of hospital stay. Mean hospital stay was reduced from 7.8±5.7 days to 6.5±5.6 days ($p<0.001$) (Table-7).

Discussion

The study demonstrated that appropriate timing of preoperative antibiotic is associated with decreased overall postoperative infection rate and severity. Almost half of the patients either did not receive preoperative antibiotic or the timing was incorrect. Similar trends of inappropriate surgical chemoprophylaxis are observed in other countries.[14] A study published in 2002 reported inappropriate chemoprophylaxis in an industrialised country.[15] SSI rate was about 1 in 3 surgeries at baseline which was reduced to almost 1 in 5 surgeries. Other studies have reported SSI rate of 8.64%.[16] A study published in 2011 showed that use of local anaesthesia was associated with less SSIs than general anaesthesia.[17] In our study the rate of SSI was higher than reported elsewhere. Some authors advocated that decrease in SSI is because of early discharge of the patient.[18] Other authors have advocated follow-up of SSI up to 1 year.[16]

A 2011 study concluded that implementation of WHO Surgical Safety Checklist improved perception of team work and safety climate among surgical teams.[19] The overall reduction in SSI rates is not limited to a single specialty, but applies to all surgical specialties.[20] A survey of clinicians showed about 95% would want to use surgical safety checklist if they were being operated upon.[21]

Conclusion

WHO Surgical Safety Checklist is a simple, reliable and effective tool which can ensure appropriate administration of intravenous antibiotic. Administration of intravenous antibiotic within 60 minutes before making the first incision reduces SSI by more than half and this should be followed for all surgical procedures requiring intraoperative or postoperative antibiotics.

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