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RESEARCH NOTE

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Pattern of antibiotics use, incidence and predictors of surgical site infections in a Tertiary Care Teaching Hospital

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Abstract

Objective: Surgical site infections (SSIs) were the most common healthcare-associated infection mainly in developing countries. Inappropriate use of surgical antibiotic prophylaxis, in terms of antibiotic choice, timing, and duration, can lead to the selection of resistant microorganisms and high costs. The aim of this study was to investigate the pattern of antibiotic use, incidence and predictors of SSIs at Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia.

Results: From 131 patients, 55.7% were male study participants. Ninety (68.7%) patients received preoperative prophylaxis. Ceftriaxone was the most 76 (84.5%) prescribed agent for prophylaxis. Twenty-seven (20.6%) patients developed surgical site infection. Previous surgery AOR = 3.22 (95% CI [1.14–9.13]) and alcohol use AOR = 7.04 (95% CI [2.56–23.12, p = 0.000]) were independent predictors of SSIs in multivariate logistic regression analysis.

Keywords: Pre and postoperative antimicrobial prophylaxis, Tikur Anbessa Specialized Hospital

Introduction

Surgical site infection (SSI) is an infection that happens within 30 days of operation or after 1 year if the implant is placed at or near the surgical incision [1]. It accounts for 17% of all healthcare associated infections and are the second most common hospital-acquired infections in study conducted in Ethiopia [2] and especially during post-operation period [3]. Globally, SSI rates have been found to be from 2.5 to 41.9%. In Africa, SSIs were the leading infections in hospitals (pooled cumulative incidence of 5.6 per 100 surgical procedures), strikingly higher than proportions recorded in developed countries [1] as 13, 20.6, 10.9 and 10.9–75% rate of SSIs were reported in Nigeria [4], Cameron [5], Tanzania [6] and Ethiopia [2, 7] studies respectively.

The extent of microbial contamination at an incision site, host factors (such as age, nutritional status, lifestyle, comorbidities, immune-competency and coexisting infections), the length of the preoperative hospital period, preoperative procedures and the duration and performance of the operation contribute to increased risks of SSIs [8]. Patient characteristics possibly associated with increased risk of SSIs include coincident remote site infections or colonization, diabetes, cigarette smoking, systemic steroid use, obesity (> 20% ideal body weight), extremes of age, poor nutritional status, and perioperative transfusion of certain blood products [9].

SSIs can have a devastating impact on the patient's course of treatment and is associated with increased treatment intensity, prolonged length of stay and higher costs [10]. A study in the United States of America suggested that programs that reduce the incidence of surgical site infections can substantially decrease morbidity and mortality and reduce the economic burden for patients and hospitals [11]. Despite improvements in operating room practices, instrument sterilization methods, better surgical technique and the best efforts of infection prevention strategies, SSIs remain a major cause of hospital-acquired infections and rates are increasing globally even in hospitals with most modern facilities and standard protocols of preoperative preparation and antibiotic prophylaxis [1].

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Another well-documented approach is to use pre and postoperative antimicrobial prophylaxis. From patients that received antimicrobial prophylaxis 30–90% are inappropriate; most antimicrobials are either given at the wrong time, wrong dosage and wrong strength which results in increased antibiotic usage, increased costs, prolonged hospitalization, super infection, antimicrobial resistance and reduction of surgical antimicrobial prophylaxis (SAP) used [12, 13].

Although the high incidence of SSI is suspected in Ethiopia, the magnitude of the problem is not known in TASH. It becomes therefore essential to determine the pattern of antibiotic use in surgical wards and occurrence and predictors of SSIs.

Main text

Methods

Study setting

The study was conducted in Tikur Anbessa Specialized Hospital (TASH) Addis Ababa, Ethiopia. TASH is one of the largest tertiary level, referral and teaching hospitals in the country, affiliated to Addis Ababa University. TASH has approximately 570 beds and out of this, 150 are allocated to surgical patients.

Study design and period

A prospective observational study was undertaken from April 1 to April 30, 2017. The source population was all inpatients admitted to the hospitals and undergone surgery, whereas the study population was all patients who had undergone operation and admitted to surgical ward during the study period.

Inclusion and exclusion criteria

All surgical patients who had operated during the study period and hospitalized up to 30 days were considered as eligible for the study. However, patients from other wards of the hospital (internal medicine, intensive care unit, emergency) and patients who died or left before third postoperative days and those not voluntary to participate were excluded from the study.

Sample size and sampling technique

Convenient sampling was used in as sampling technique in this study. Accordingly, all patients who had undergone surgical procedures are followed from admission until discharge, including any readmissions for infection. Accordingly, 131 patients were enrolled in our study.

Data collection, management and quality assurance

Socio-demographic characteristics of the patients, surgery-related information(site of surgery, duration of surgery, previous history of surgery, surgery type, hospital stay after surgery, wound class and occurrence of SSI after surgery within 30 days), antibiotic used (preoperative and postoperative antibiotic used, duration of antibiotics after surgery) were collected using data abstraction tool from patient's medical chart. The tool was developed from literatures and modified at it suits to study setting up and senior clinical pharmacist was consulted for its appropriateness. Patients were interviewed in case the information couldn't be obtained from their chart to make the data complete. Antimicrobial use evaluation was done according to Center for Disease Prevention and Control (CDC) criteria for using antimicrobials in surgical site infection (SSI) prevention and treatment [9]. In our set up, SSI diagnosed mainly by interpretation of clinical (sign and symptom manifestation) findings and also incorporating CDC definition and methodology. It is rare to use laboratory results (culture testing) in diagnosing SSI in the studied hospital. Incidence and risk factors for SSI, including those for specific procedures were calculated from data collected on daily base. Before the actual data was collected, a pretest of the data collection instrument was done to ensure the appropriateness of questionnaire and necessary modifications were made.

Data entry and analysis

Data was entered into and analyzed by SPSS version 20. Logistic regression analysis was used to identify predictors of SSI. In all cases, p-value less than 0.05 are taken as statistically significant. Variables which have a significant association at p-value < 0.25 in the bivariate logistic regression analysis were candidates for multivariate logistic regression analysis to identify predictors of SSIs.

Ethical considerations

Ethical clearance was obtained from the ethics review committee of School of Pharmacy, College of Health Sciences, Addis Ababa University. Additionally written consent was taken from each participant before participating in the study.

Results

Socio-demographic characteristics

During the study period, a total of 158 patients underwent surgery in selected wards of the hospital. From the total, 27 patients were excluded by exclusion criteria (refused to provide consent or death or discharged too early after surgery) and finally, 131 patients were considered for analysis. The age of the patients ranged from 2 to 86 years with a mean of 41.15 ± 18.29 years. Twenty-two (16.8%) and 41 (31.3%) patients were smokers and alcohol drinkers respectively (Table 1).

Table 1 Socio-demographic and clinical characteristics of patients at surgical wards of TASH (N = 131)

Socio-demographic and clinical characteristics	N (%)
Gender	
Female	58 (44.3)
Male	73 (55.7)
Age in years	
< 30	39 (29.8)
30–50	40 (30.5)
> 50	52 (39.7)
Residence	
Urban	71 (54.2)
Rural	60 (45.8)
Cigarette smoking	
No	109 (83.2)
Yes	22 (16.8)
Alcohol intake	
No	90 (68.7)
Yes	41 (31.3)
Preoperative blood transfusion	
No	101 (77.1)
Yes	30 (22.9)
Systemic steroid use	
No	115 (87.8)
Yes	16 (12.2)
Preoperative hospital stay (days)	
> 7	62 (47.3)
≤ 7	69 (52.7)
Co-morbidities	
Cardiovascular disease	20 (15.3)
Hypertension	9 (6.9)
Diabetes mellitus	2 (1.5)
HIV/AIDS	5 (3.8)
Infection[a]	8 (6.1)
Multiple co-morbidities	7 (5.3)
Others[b]	6 (4.6)
Wound class	
Clean	43 (32.8)
Clean contaminated	64 (48.9)
Contaminated	16 (12.2)
Dirty	8 (6.1)
Surgery type	
Emergency	25 (19.1)
Elective	106 (80.9)
Previous surgery	
No	98 (74.8)
Yes	33 (25.2)

Infection[a]: infections other than SSIs. Others[b] include cancer, psychotic disorders, asthma, and epilepsy

Clinical characteristics and co-morbidities of the patients

Nearly half of patients (47.3%) stayed in hospital for more than 7 days before surgery was conducted. Fifty-seven (43.5%) of the study participants had various types of co-morbidities beside their surgery indications. Six (4.6%) of them had more than co-morbidities (Table 1). About half of patients (48.9%) who underwent operation had clean contaminated wounds at the time of surgery and the mean duration of operation was 2.21 ± 1.53 h. One hundred six (80.9%) of the operations were elective surgery. One-fourth of patients had a history of previous procedure (Table 1).

Practice and appropriateness of surgical antimicrobial prophylaxis

Among 131 patients, more than two-third of (68.7%) patients received preoperative antimicrobial prophylaxis. Out of the 43 and 64 patients who had a clean and clean contaminated wound, 15 (34.9%) and 58 (90.6%) patients received pre-operative antimicrobial prophylaxis respectively. From all patients that took preoperative antimicrobial prophylaxis eighty (88.9%) patients received antimicrobial prophylaxis for greater than 24 h after surgery. The majority of patients received ceftriaxone 76 (84.5%). The most commonly prescribed regimen among the combination regimens was ceftriaxone plus metronidazole 12 (13.3%) (Table 2).

Incidence of surgical site infections

Among a total of 131 patients who underwent surgical procedures, SSI was developed in 27 (20.6%) patients before discharge. Among the detected SSIs, 23 (85.2%) and 4 (14.8%) were superficial and deep infections respectively.

Factors associated with surgical site infections

Bivariate logistic regression model showed seven variables were associated with the occurrence of SSIs at $p < 0.25$. Alcohol ($p = 0.000$), cigarette smoking ($p = 0.05$), preoperative blood transfusion ($p = 0.05$), contaminated ($p = 0.17$) and clean wound ($p = 0.12$), previous surgery ($p = 0.01$), and duration of surgery ($p = 0.20$) were candidate variables for multivariate analysis. The remaining factors were not associated with SSIs in studied participants (see Additional file 1).

Predictors of surgical site infections

Upon further analysis using multivariate analysis to evaluate whether these variables are independent predictors of SSIs, alcohol use and previous surgery were found to be independently associated with development of SSIs

Table 2 Practice and appropriateness of surgical antimicrobial prophylaxis in surgery patients in TASH (N = 131)

Practice of antimicrobial prophylaxis(AMP)	N (%)
Preoperative AMP provision	
Yes	90 (68.7)
No	41 (31.3)
Preoperative provided antibiotics	
Ceftriaxone	76 (84.5)
Ceftriaxone and metronidazole	12 (13.3)
Ampicillin	2 (2.2)
Time of administration of preoperative AMP (h)	
≤ 1	34 (37.8)
>1	56 (62.2)
Duration of postoperative AMP (h)	
≤ 24	10 (11.1)
> 24	80 (88.9)
Indication of AMP	
Indicated and administered	73 (91.25%)
Not indicated and not administered	34 (66.7%)
Indicated but not administered	7 (8.75%)
Not indicated but administered	17 (33.3%)

(AOR = 7.70, p = 0.000), (AOR = 3.22, p = 0.028). However, other socio-demographic and clinical characteristics were not independently predictors of SSIs (Table 3).

Discussion

In this study, majority of patients who underwent surgical procedures received antimicrobial prophylaxis which is in line with another study [12]. However, proper AMP practice in this setup was not parallel with recommendations of the clinical practice guideline for antimicrobial prophylaxis in surgery [14, 15].

In this study, none of the patients received cefazolin even if it is recommended by guideline [14] in the prevention of most surgery related infections. The most commonly prescribed drug for AMP was ceftriaxone, followed by metronidazole, and it is comparable to study done in Brazil [16]. For surgical prophylaxis, it is important to select an antimicrobial with narrowest antibacterial spectrum to reduce the emergence of resistance and as for covering the most likely contaminating microorganisms for that type of surgery [14]. In all patients that received antimicrobial prophylaxis selection of antimicrobials were not consistent with the recommendations of the guidelines which may be due to the absence of their own guideline, the assumption of ceftriaxone

Table 3 Predictors of SSI development in surgery patients in TASH (N = 131)

Variables	Surgical site infection		COR (95% CI)	AOR (95% CI)	p value
	Yes N (%) 27 (20.6)	104 (79.4%)			
Preoperative blood transfusion					
Yes	10 (33.3%)	20 (66.7%)	2.47 (0.98–6.21)	1.34 (0.45–4.02)	0.602
No	17 (16.8%)	84 (83.2%)		1	
Cigarette smoking					
Yes	8 (36.4%)	14 (63.6%)	2.71 (0.1–7.36)	0.80 (0.23–2.80)	0.725
No	19 (17.4%)	90 (82.6%)		1	
Alcohol					
Yes	18 (43.9%)	23 (56.1%)	7.04 (2.78–17.75)	7.70 (2.56–23.13)	0.000
No	14 (14.74%	81 (85.26%)		1	
Wound class					
Clean	6 (13.95%)	37 (86.05%)	0.27 (0.05–1.44)	0.53 (0.07–4.08)	0.543
Clean contaminated	16 (25%)	48 (75%)	0.56 (0.12–2.59)	1.04 (0.16–6.57)	0.966
Contaminated	2 (12.5%)	14 (97.5%)	0.24 (0.03–1.87)	0.67 (0.06–7.24)	0.745
Dirty	3 (37.5%)	5 (62.5%)		1	
Previous surgery					
Yes	12 (36.4%)	21 (63.6%)	3.16 (1.29–7.76)	3.22 (1.14–9.13)	0.028
No	15 (15.3%)	83 (84.7%)		1	
Duration of surgery (h)					
>1	19 (24.1%)	60 (75.9%)	1.81 (0.73–4.51)	2.16 (0.72–6.48)	0.169
≤ 1	8 (15.4%)	44 (84.6%)		1	

AOR adjusted odds ratio, *COR* crude odds ratio

similar with cefazolin or unavailability of first generation cephalosporins.

Administration of AMP should be within 1 h prior to incision to achieve adequate protection [17]. In our study, only 37.8% of patients received preoperative antibiotics within 1 h prior to incision which is in agreement with Brazilian study [16]. However, AMP administration time is not recorded in 17 (18.9%) patients may be due to work overload on attending nurses, the absence of separate sheet for recording time of administration and lack of awareness to record AMP administration time which is consistent with other studies [12].

Results from other study showed that duration of AMP was longer than 24 h in 30–90% of cases after surgery [18] and similarly this was observed in nearly 90% of our study participants. In general, single-dose prophylaxis or prophylaxis ending within 24 h after operation is recommended by guidelines [14]. Prolonged postoperative dosing of antibiotics does not provide additional benefits and is associated with increased risk of adverse events and induction of antimicrobial resistance [14, 15].

In most part of the world depending on the set up of their hospitals and their degree of adherence to aseptic techniques, the SSI rate has varied from a low of 2.5% to a high of 41.9% [19–22]. The incidence rate of SSIs found in the present study was 20.6%. It was higher than previous findings from developing country hospital 14.8% [23] and from USA 7.2% [24]. However, SSIs rate was similar to the study done in India 20.09% [25], and Nigeria 20.3% [26] and Ethiopia 19.1% [1]. But, it was more than three times lower when compared with the study conducted in Ethiopia 75% [7]. The elevated SSI rates can be explained by the using clinical evidence than laboratory in the studied set up to detect SSI and limited ventilation in the operating theatre, as well as limited application of infection control measures.

In this study, alcohol use and having previous surgery was significant predictors of postoperative SSIs. The present study showed that patients with drinking alcohol were 7.70× more likely to develop SSIs compared with patients who do not drink alcohol with AOR = 7.04 (95% CI [2.56–23.12, p = 0.000]), and another study reported similar association [3]. Patients who had history of previous surgery were 3.16 times more likely to develop SSIs compared with those who hadn't previous surgery with AOR = 3.22 (95% CI [1.14–9.13]), which was in agreement with another study [27]. Higher incidence of SSI in patients with previous surgery may be due to exposure to long operation time, difficult surgery, high class wounds and using the same incision site with the previous one.

Some studies have examined the use of the ASA score as a predictor of SSI risk [20, 28]. The ASA score approximates 'global' patient health at the time of the operation and is a reliable predictor of the risk of SSI [29]. This may be because these procedures were mainly performed on relatively normal physical activity before admission, which may limit the utility of the ASA score as a discriminator of risk. According to this study emergent surgeries (24%) had higher rates of SSI than elective procedures (19.8%). This is because, as emergency operations should be higher risk because of suboptimal preoperative preparation and because they are more likely to be dirty.

Limitations

We used smaller sample size and shorter study period which might have an impact on some of the results reported. Other factors have been known to influence the risk of SSIs, such as operation characteristics and nutritional status, antiseptic usage, and sterilization techniques and quality of operation theatre was not studied in this study.

Additional file

Additional file 1. Factors associated with SSIs occurrence among surgical patients in TASH (N = 131). It is additional material which describes bivariate logistic regression model showing seven variables were associated with the occurrence of SSIs at p < 0.25. Alcohol (p = 0.000), cigarette smoking (p = 0.05), preoperative blood transfusion (p = 0.05), contaminated (p = 0.17) and clean wound (p = 0.12), previous surgery (p = 0.01), and duration of surgery (p = 0.20) were candidate variables for multivariate analysis. The remaining factors were not associated with SSIs development in studied participants.

Abbreviations

AMP: antimicrobial prophylaxis; AOR: adjusted odds ratio; SAP: antimicrobial prophylaxis; SSI: surgical site infection; TASH: Tikur Anbessa Specialized Hospital.

Authors' contributions

SH conceived the study idea. EH developed the study design, conducted the study and analyzed data and it was enriched and approved by TA and SH. SH and TA did critical revisions of the manuscript for its important intellectual content. All authors read and approved the final manuscript.

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Competing interests

The authors declare that they have no competing interests.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Consent for publication

Not applicable.

Ethics approval and consent to participate

Ethical clearance was obtained from the ethics review committee of School of Pharmacy, College of Health Sciences Addis Ababa University. Additionally written consent was taken from each participant before participating in

the study. During the consent process, they were provided with information regarding the purpose of the study, why and how they were selected to be involved in the study and what will be expected from them.

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References

1. Laloto TL, Gemeda DH, Abdella SH. Incidence and predictors of surgical site infection in Ethiopia: prospective cohort. BMC Infect Dis. 2017;17:1–9.
2. Mulu W, Kibru G, Beyene G, Demtie M. Postoperative infections and antimicrobial resistance pattern of bacteria isolates among patients admitted at felege Hiwot Refferal Hospital, Bahirdar, Ethiopia. Ethiop J Health Sci. 2012;22:7–18.
3. Hedrick TL, Sawyer RG, Friel CM, Stukenborg GJ. Method for estimating the risk of surgical site infection in patients with abdominal colorectal procedures. Dis Colon Rectum. 2013;56:627–37.
4. Amoran OE, Sogebi AO, Fatugase OM. Rates and risk factors associated with surgical site infections in a tertiary care center in South-Western Nigeria. Int J Trop Dis Heal. 2013;3:25–36.
5. Ngowe MN, Toure A, Mouafo FT, Chichom A, Tchounzou R, Ako-Egbe L, et al. Prevalence and risk factors associated with post operative infections in the Limbe Regional Hospital of Cameroon. Open Surg. 2014;8:1–8.
6. Mpogoro FJ, Mshana SE, Mirambo MM, Kidenya BR, Gumodoka B, Imirzalioglu C. Incidence and predictors of surgical site infections following caesarean sections at Bugando Medical Centre, Mwanza, Tanzania. Antimicrob Resist Infect Control. 2014;3:1–10.
7. Mengesha RE, Kasa BG, Saravanan M, Berhe DF, Wasihun AG. Aerobic bacteria in post surgical wound infections and pattern of their antimicrobial susceptibility in Ayder Teaching and Referral. BMC Res Notes. 2014;7:1–6.
8. Cooper RA. Surgical site infections: epidemiology and microbiological aspects in trauma and orthopaedic surgery. Int Wound J. 2013;10:3–8.
9. Mangram AJ, Horan TC, Silver Pearson ML, Jarvis WR, Guideline for Prevention of Surgical Site Infection. Centers for disease control and prevention (CDC) Hospital Infection Control Practices Advisory Committee. Am J Infect Control. 1999;1999(27):97–132.
10. De Lissovoy G, Fraeman K, Hutchins V, et al. Surgical site infection: incidence and impact on hospital utilization and treatment costs. Am J Infect Control. 2009;35:387–97.
11. Kirkland KB, Briggs JP, Trivette SL, et al. The impact of surgicsl site infection in the 1990s: attributable mortality, excess length os hospitalization, and extra costs. Infect Control Hosp Epidemiol. 1999;20:725–30.
12. Argaw NA, Shumbash KZ, Asfaw AA. Assessment of surgical antimicrobial prophylaxis in orthopaedics and traumatology surgical Unit of a Tertiary Care Teaching Hospital in Addis Ababa. BMC Res Notes. 2017;10:6–13.
13. Ciofi M, Alegiani SS, Raschetti R, Arace P, Giusti A, Spiazzi R, et al. Surgical antibiotic prophylaxis in children: adherence to indication, choice of agent, timing, and duration. Eur J Clin Pharmacol. 2015;71:483–8.
14. Bratzler DW, Dellinger EP, Olsen KM, Perl TM, Auwaerter PG, Bolon MK, et al. Clinical practice guidelines for antimicrobial prophylaxis in surgery. Am J Heal Pharm. 2013;70:195–283.
15. Scottish Intercollegiate Guidelines Network. Antibiotic prophylaxis in surgery. 2014. http://www.sign.ac.uk. Accessed 15 June 2018.
16. Rana DA, Malhotra SD, Patel VJ. Inappropriate surgical chemoprophylaxis and surgical site infection rate at a tertiary care teaching hospital. Braz J Infect Dis. 2013;17:48–53.
17. Thomas MF. Guidelines for Antimicrobial Prophylaxis in Surgery. Infect Dis ClinPract. 2013;21:185–6.
18. Elbur AI, Ma Y, Sayed A, Elsayed A, Abdel-Rahman EM. Prophylactic antibiotics and wound infection. J Clin Diagn Res. 2013;7:2747–51.
19. Demisew A, Tefera B, Fitsum A. Surgical site infection rate and risk factors among obstetric cases of Jimma University Specialized Hospital, Southwest Ethiopia. Ethiop J Health Sci. 2011;21:99–100.
20. Jasim HH, Sulaiman SAS, Khan AH, Dawood TO, Abdulameer HA, Usha R. Incidence and risk factors of surgical site infection among patients undergoing cesarean section. Clin Med Insights. 2017;9:1–7.
21. Gonçalves da Silva QC, Barbosa MB. Risk factors for surgical site infection in cardiac surgery. Acta Paul Enferm. 2012;25:89–95.
22. Linda T. Infection prevention Guidelines for healthcare facilities with limited resources. 5th ed. Berlin: Springer; 2003.
23. Taye M. Wound infection in Tikur Anbessa hospital, surgical department. Ethiop Med J. 2005;43:167–74.
24. Garey KW, Dao T, Chen H, Amrutkar P, Kumar N, Reiter AM, et al. Timing of vancomycin prophylaxis for cardiac surgery patients and the risk of surgical site infections. J Antimicrob Chemother. 2006;58:645–50.
25. Mahesh CB, Shivakumar S, Suresh BSCS. A prospective study of surgical site infections in a teaching hospital. J Clin Diagn Res. 2010;4:3114–9.
26. Nwankwo EO, Ibeh INEO. Incidence and risk factors of surgical site infection in a tertiary health institution in Kano, Northwestern Nigeria. Int J Infect Control. 2012;8:8–13.
27. Haridas M, Malangoni MA. Predictive factors for surgical site infection in general surgery. Surgery. 2006;144:496–503.
28. Cheng K, Li J, Kong Q, Wang C, Ye N, Xia G. Risk factors for surgical site infection in a teaching hospital: a prospective study of 1138 patients. Patient Prefer Adher. 2015;9:1171–7.
29. Woodfield JC, Beshay NMY, Pettigrew RA, Plank LD, van Rij AM. American Society of anesthesiologists classification of physical status as a predictor of wound infection. ANZ J Surg. 2007;77:738–41.