Bratisl Lek Listy 2011; 112 (5)
273 – 277

CLINICAL STUDY

Positive associations of nosocomial infections in surgical ward with etiological clinical factors

Faruquzzaman

Chittagong Medical College Hospital Chittagong, Bangladesh. **drfaruquzzaman@yahoo.com**

Abstract: This study was conducted in the surgical wards of Dhaka Medical College Hospital, Bangladesh (General Surgery Wards and burn unit) on nosocomial infection. Thirty percent of the study patients, of which, elderly patients constitute 62.5 %, were infected with nosocomial infection. Among those patients, wound infection (38.7 %) was the most common type of nosocomial infection, from which about 63.5 % belonged to postoperative. The other common types were acute respiratory tract infection (19.2 %), urinary infection (26.6 %), and gastro-intestinal infection (12.5 %). In this study, it was found that combined infection (36 %), pseudomonas (33 %) as well as E. coli (17 %) had the greatest contribution of developing postoperative wound infection. Nosocomial infection was not significantly associated with sex distribution, but was significantly higher in postoperative patients (63.5 %) than preoperative (36.5 %). Another significant finding of this study was that there was a strong positive association between the frequency of nosocomial infections and increasing number of visitors per patient per day) *(Tab. 6, Fig. 4, Graph 2, Ref. 26)*. Full Text (Free, PDF) *www.bmj.sk.*
Key words: nosocomial infections, surgical ward, etiological clinical factors.

Nosocomial or hospital acquired infections are now a burning question in the surgical ward of the third world countries and of the whole world as well, in both developing and developed countries. This is the number one cause of mortality and morbidity in hospitalized patients in surgical wards at present, leading directly or indirectly to an enormous increase of cost of the hospital care. In the United States, nosocomial infection added an extra cost of 3 to 10 billion dollars annually to hospital costs, where it occurred at a rate of 5–10 % in 1987 (1). A number of studies (2, 3, 4) have been carried out in the different parts of the world on the incidence and the prevalence rates of the nosocomial infection, its epidemiology, and economical involvement of hospital acquired infection. There are different projects, which provided important information on controlling the nosocomial infection. One of the most common hospital acquired infections is wound infection. Not only in developing countries but also in developed countries wound infection is now a burning question. Wound infection has probably been a major complication of surgery and trauma. It has been documented for at least 4000–5000 years (5).

Although ubiquitously, nosocomial infection causes are associated particularly with the departments of surgery. The nosocomial infection rate in this study has been found to be 48 %, which is quite higher. In developing countries, some studies had been carried out to find out the nosocomial infection rate, but not satisfactory as Western et al (7). reported that the nosocomial infection rate could be as high as 26–65 % in developing countries (8). The study held on Dhaka Medical College Hospital at 1991 suggested that wound infection was the highest (36.1 %) followed by UTI (23.6 %). The prevalence of nosocomial infection was found to be significantly higher (60 %) in postoperative patients than preoperative patients (38.4 %), found in this study. The frequency of different types of nosocomial infections depends upon the quality and quantity of work load and hospital environment. High frequency of infection especially in postoperative wards and also other wards indicates a breach of asepsis somewhere in the operation theatre, postoperative ward and/or in other wards. Anaesthetic hazards may also be responsible to some extent (8, 9).

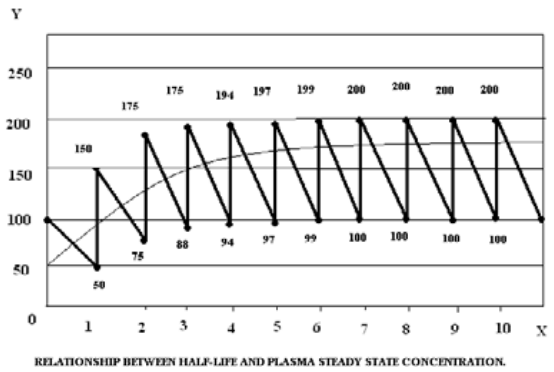
A cross- sectional study on nosocomial infection in Dhaka Medical College Hospital, Bangladesh at 1991 revealed that it was about 30 % (10). Skimming through different studies it has been observed that the rate of nosocomial infection varied from a lowest of 4.8 % to highest 11 % in developed countries. In England, Meer et at (9) reported a prevalence of 11 % and Ortons et al (11) observed 6.7 % of nosocomial infection per 100 discharges in Rome.

The lower nosocomial infection rate in the hospital of developed countries indicates an increasing awareness about nosocomial infection. The study on the efficacy of nosocomial infection control, the comprehensive hospital infection project and the national nosocomial infection studies play an important role in reducing the nosocomial infection (8).

Chittagong Medical College Hospital Chittagong, Bangladesh

Address for correspondence: Faruquzzaman Dr, C/O: Md. Moazzem Hossain (Engineer), House No. 7, Islambag Road (Paulpara), Railygate, Daulatpur (Postal code 9202), Bangladesh.
Phone: +8801713312349

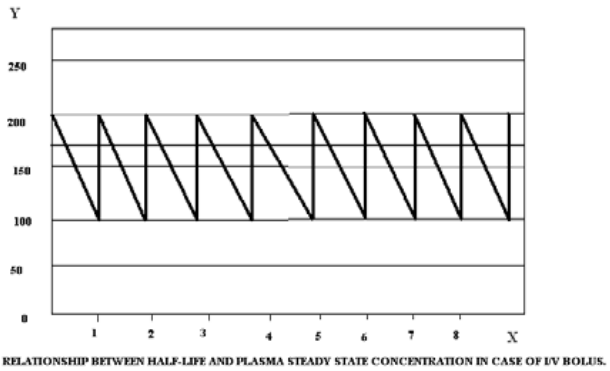
Acknowledgement: I am highly grateful to my respected teacher, Dr. Saroj Kumar Mazumder; the honorable head of the Department of community medicine, Chittagong Medical College, Bangladesh, for his kind support and help in conducting this study.



RELATIONSHIP BETWEEN HALF-LIFE AND PLASMA STEADY STATE CONCENTRATION.

Y axis= Plasma drug concentration (µg/ml)
X axis= half life, t1/2 =4 hours.
Note to the following:
Although it takes > 7, t1/2 to reach the steady state mathematically, by convention clinical steady state is accepted to be reach at 4-5, t1/2.
So the relation between the steady state and time are as follows:
50% =1× half life.
90% =3.3× half life.
95% =4-5× half life.
100% = >7× half life.

Graph 1



RELATIONSHIP BETWEEN HALF-LIFE AND PLASMA STEADY STATE CONCENTRATION IN CASE OF I/V BOLUS.

Y axis= Plasma drug concentration (µg/ml)
X axis= half life, t1/2 =4 hours.

Graph 2

Attendants and visitors have also a role in development of nosocomial infection. They are addition load for proper hospital management and effective and efficient patient care (12, 13).

In the case of a contaminated emergency surgery, prophylaxis antibiotic coverage should be ensured to achieve the steady state concentration. Ideally, maximum blood and tissue levels should be present at the time that the first incision is made, before contamination occurs. An intravenous administration at induction of anaesthesia is optimal (14, 15, 16).

The steady state concentration (17, 18).

Steady state is reached when rate in = rate out or when values associated with one dosing interval are the same as those in succeeding interval.

Plateau principle:

The time to reach the steady state is depending on the elimination half life of a drug and is independent of dose size and frequency of administration. The following figure shows the plasma level (bold solid line) achievement following the I/V bolus administration of a drug at an interval equivalent to every half life, $t_{1/2}$ =4 hours. With such intermittent dosing, plasma level oscillates through peak and through, with averages show in the diagram by the light solid line (graph 1).

The effect of loading dose: it takes 4–5 half life to achieve the steady state. In some situations, it may be necessary to give a higher dose (loading dose) to more rapidly achieve effective blood levels (graph 2).

Such loading doses are often one time only and are estimated to put into the body the amount of drug that should be there at a steady state. If doses are to be administrated each half life of the drug, then the loading dose is the twice the amount of the dose used for maintenance.

Wound abscess is another important complication of surgical ward. Pyogenic organisms, *S. aureus* cause tissue necrosis and putrefaction. Most abscess take 7–9 days to form after a surgical infection. As many as 75 % of infection may present after the patient has left hospital and thus may be overlooked by the team. The role of antibiotics in treatment of wound abscess is controversial unless there is no sign of cellulitis, lymphangitis and related sepsis (19, 20, 21).

Treatment of commensals that become opportunist pathogens (22, 23).

1) They are likely to have multiple antibiotic resistances.

2) It may be necessary to rotate antibiotics.

Wound infections results from bacterial contamination of the wound. Infection rate is proportionate to (24):

a) Number of bacteria.
b) Type of bacteria.
c) Sites of existing infection in the body.
d) The use of prosthetic implants.

Technique of sterilization (25):

1) Steam (121 degree C for 15 minutes): instruments

2) Ethylene oxide: heat-sensitive equipments

3) Hot air: sharp, delicate instruments

4) Steam (73 degree C) and formaldehyde: heat-sensitive equipment, plastics

5) Irradiation: industrial packing

6) Peracetic acid (STERIS): flexible endoscope

Ringworm is named for the ring-shaped raised patches that appear on infected skin. The fungi that cause ringworm usually infect moist areas of the body. The contagious condition often produces itchy or blistered patches of skin (26).

Discovery of Penicillin

British bacteriologist Alexander Fleming discovered penicillin in 1928. Penicillin, an important antibiotic derived from mold, is effective against a wide range of disease-causing bacteria. It acts by killing bacteria directly or inhibiting their growth (26).

Incidence of hospital acquired Tuberculosis, United States since 1985 to 2004 (27)

Recently, a study on this matter, which was held in a very grass-root level in India, suggested that only awareness and health education among the people can reduced the incidence to a significant level.

A volunteer working for the United States Agency for International Development (USAID) gives a class in personal hygiene to women in New Delhi, India (26).

Methods and materials

1) Type of study: Descriptive type of epidemiological cross-sectional study.

2) Place of study**:** The general surgery indoor department as well as burn unit of Dhaka Medical College Hospital, Bangladesh.

3) Period of study**:** From 15.04. 08 to 08.11.08.

4) Study population**:** Patients, admitting to the general surgery indoor department as well as burn unit of Dhaka Medical College Hospital.

5) Sample size**:** 450

The sample size was selected by using the formula $Z^2pq \times D$

Where, Z= Given confidence level (Z=1.96 for 95 % confidence level)

p=Probability =20 %=0.20

q=1.0-p=0.8 (C_1-p)

Degree of error limit (the accuracy desired)

6) Sampling technique**:** Convenient type of purposive sampling.

7) Data collection instruments**:** a) prepared questionnaires b) direct observation c) active participation

8) Data collection period**:** From 15.4.2008 to 1.11.2008.

9) Methods of data collection**:** a) interviewing through questionnaires b) direct observation

10) Data analysis: After collection, data were checked, verified, compared, reviewed and analyzed according to the objectives and purposes of the study.

Using computer based statistical package, a statistical analysis of the data was done. Data was analyzed with the SPSS computer package programme. The survey data was analyzed using a descriptive statistic. Such as; mean, SD, percentage, co-efficient of variation.

The report was produced by a computer based program-Microsoft Word, Power point, Photoshop, Adobe and other accessories.

Results

This study was conducted on a total number of 450 patients admitted in 3 different general surgery wards as well as in burn unit of Dhaka Medical College Hospital, Bangladesh during the period of the study. Out of 450 patients, 279 (62 %) were male and 171 (38 %) were female. The majority patients belonged to 45–59 years of age, 184 (40.89 %), followed by 30–44 years of age, 89 (19.78 %).

Tab. 1. Age and sex distribution of the study population.

Age in year	Male	Female	Total
0–14	55	21	76 (16.89 %)
15–29	25	28	53 (11.78 %)
30–44	50	39	89 (19.78 %)
45–59	119	65	184 (40.89 %)
> 60	30	18	48 (10.67 %)
	279 (62 %)	171 (38 %)	450 (100 %)

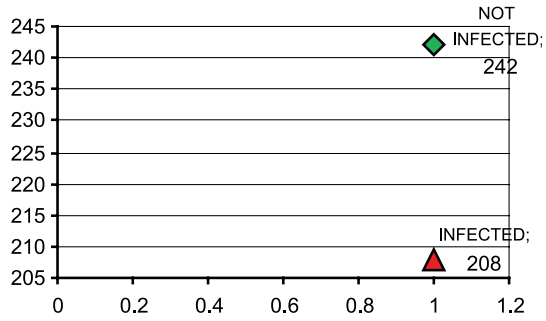


Fig. 1. Percentage of nosocomical infection.

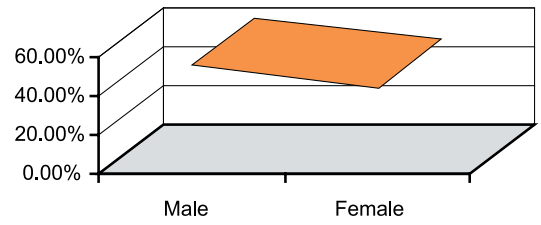


Fig. 2. Sex distribution.

Out of 450 patients, 216 (46.2 %) suffered from various types of nosocomial infections (Fig. 1), of which 116 (55.8 %) were male and 92 (44.2 %) were female (Fig. 2).

Out of these 208 nosocomial infected patients, 80 (38.7 %) suffered from wound infection followed by 40 (19.2 %) from ARI, 38 (26.6 %) from UTI, 26 (12.5 %) from gastrointestinal infections (Tab. 2).

The nosocomial infection rate was 63.5 % among the post-operative patients whereas it was only 36.5 % among the preoperative patients (Tab. 3).

The age distribution of nosocomial infection is given in table 4, which reveals that 62.5 % of patients were over 60 years of age followed by 15.7 % were below 14 years.

Tab. 2. Clinical types of nosocomical infection.

Infected	wound infection	ARI	UTI	Gastrointestinal	Skin	Others
216	80	40	38	26	18	4
100%	38.7%	19.2%	26.6%	12.5%	8.7%	1.9%

Tab. 3. Distribution of nosocomical infection by the stage of operation.

Period	Patients	Infections	%
Preoperative	250	76	36.5%
Postoperative	200	132	63.5%
Total	450	208	46.2%

Tab. 4. Age distribution of nosocomical infection.

Age in year	Patients	Infected	%
0–14	76	12	15.7
5–29	53	3	5.7
30–44	89	7	7.9
45–59	184	15	8.2
>60	48	30	62.5
Total	450	67	100

Tab. 5. Distribution of nosocomical infection by the pattern of admission.

Admission	Patients	Infected	%
OPD	164		
Emergency	286	32	19.6
Total	450	76	28.4

Tab. 6. Relationship between the number of visitors and prevalence of nosocomical infection.

Visitor/Patient/Day	Study population	Infected patients	%
0–2	60	8	13.3
3–5	240	53	22.1
6–8	123	34	27.6
> 8	27	10	37
Total	450	105	100

The nosocomial infection rate was 28.4 % among the operated emergency cases and it was 19.6 % among the scheduled operated cases (Tab. 5)

Table 6 shows that the prevalence of nosocomial infection was 37 % among the patients visited by >8 visitors per day on average whereas, it was 13.3 % in those patients who had the least number of visitors (0–2 per day).

Figure 3 reveals that in most of the cases, nosocomial infections were combined in type (34 %) followed by pseudomonas (30 %).

Discussion and comparison with other studies

In the third world countries, including our beloved motherland Bangladesh, nosocomial infection is a burning question and remains still a problem of increasing importance in hospital practice. Although ubiquitously, nosocomial infection causes are associated particularly with the departments of surgery. The nosocomial infection rate in this study has been found to be 48 % which is quite higher. In Bangladesh, some studies had been carried out to find out the nosocomial infection rate, but were not satisfactory as Western et al (4). reported that the nosocomial infection rate could be as high as 26–65 % in developing countries. A cross-sectional study on nosocomial infection in Dhaka Medical College Hospital, Bangladesh at 1991 revealed that it was about 30 % (5). Skimming through different studies it has been observed that the rate of nosocomial infection varied from a lowest of 4.8 % to highest 11 % in developed countries. In England, Meer et at (6) reported a prevalence of 11 % and Ortons et al (7) observed 6.7 % of nosocomial infection per 100 discharges in Rome.

The lower nosocomial infection rate in the hospital of developed countries indicates an increasing awareness about nosocomial infection. The study on the efficacy of nosocomial infection control, the comprehensive hospital infection project and the national nosocomial infection studies play an important role in reducing the nosocomial infection. Among the different types of infections encountered in this study, wound infection was the highest (38.7 %) followed by ARI (19.2 %) and UTI (26.6 %). This observation is in contrast with many studies from developed countries, where wound infection was much lower (3.9–8.7 %) and UTI was more frequent (8). The study held on Dhaka Medical College Hospital in 1991 suggested that wound infection was the highest (36.1 %) followed by UTI (23.6 %). The prevalence of nosocomial infection was found to be significantly higher (63.5 %) in postoperative patients than in preoperative patients (36.5 %), found in this study. The frequency of different types of nosocomial infections depended upon the quality and quantity of work load and hospital environment. A high frequency of infection, especially in postoperative wards and also other wards, indicates a breach of asepsis somewhere in the operation theatre, postoperative ward and/or in other wards. Anaesthetic hazards may also be responsible to some extent (9).

Attendants and visitors have also a role in development of nosocomial infection. They are an additional load for the proper hospital management and for effective and efficient patient care. This study revealed a direct relationship between the nosocomial infection and increased number of visitors (Tab. 1). The average number of visitors per patient per day was 5 in this study whereas, ideally this should not be more than 2, and also overcrowding in the wards and in front of the operation theatre may be one of the most important causes of increased frequency of nosocomial infection (10). In this study, it is clear that combined types of infections were the most common followed by pseudomonas infection (Fig. 3). Moreover, other important patient's factors of developing nosocomial infection were illiteracy, poverty, negligence etc. (Fig. 4).

Though the study was in a small scale, the revelations are quite alarming. This study revealed that the prevalence of nosocomial infection is quite high in Dhaka Medical College Hospital (General Surgery Wards), Bangladesh. This is related with overload of the wards by the patients, overcrowding by the visitors and also a breach of aseptic measure in the operation theatre, postoperative wards and surgical wards. Further studies are required however, in large scale, in different wards of a sizable number of institutes to get a more real and an accurate picture in this association.

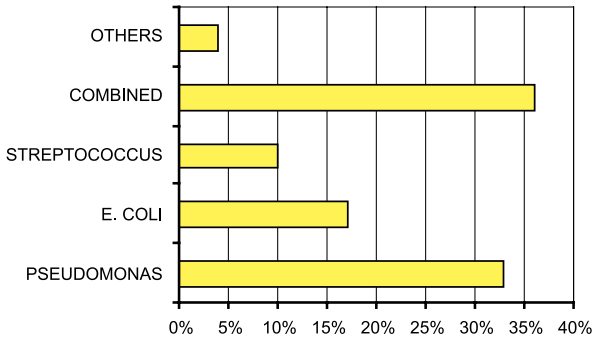


Fig. 3. Types of organisms for developing nosocomical infection.

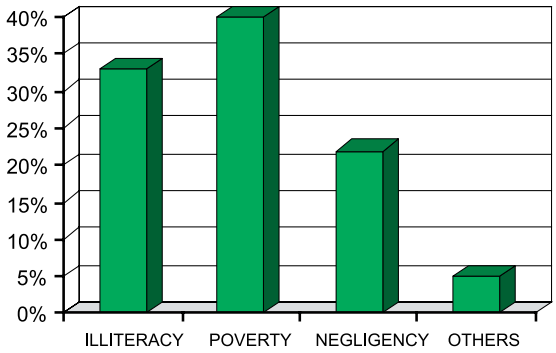


Fig. 4. Reveals some important patient's factors for developing nosocomical infection.

Conclusion and recommendation

Without any doubt, more scientific studies in a very large scale are needed just now to access the link between the nosocomial infection and risk factors in the surgical ward and to find out the alternative way to prevent nosocomial infection. These researches may be able to provide some ideas, information, which if implemented clinically, will be the very basic foundation of the conventional medical science. And I am fairly certain that these will focus on the traditional concept of clinical practice and help the policy maker to find out the appropriate as well as the most cost-effective way to eradicate the global health service financial crisis as soon as possible.

The clinical implementation of the results of these studies will certainly reduce the human mortality and morbidity from the nosocomial infection and simplify human suffering, if gain success, and the results will be utilized in planning and implementation of new health program related to health economy.

References

1. Wenzel RP. Towards a global perspective of nosocomial infections. Eur J clin Microbiol 1987; 6 (3): 341–342.

2. Ayliffle GAJ. Proceeding of the international conference on nosocomial infections, Chicago. American Hospital association, 1970: 282.

3. Haliy W, Schaber R, Allmen DV, et al. Estimating the extra charges and prolongation of hospitalization due to nosocomial infections. The J Infection Diseases, 1980; 41 (2): 248.

4. Western KA, Shearer LA. Hospital Infection Control, 1982; 3: 453.

5. Bailey and Love's. Short practice of surgery. Wound infection; 24th edition; 2005; ISBN 0340 80820 5; ISBN 0340 80820 9: 118.

6. Bailey and Love's. Short practice of surgery. Wound infection; 24th edition; 2005; ISBN 0340 80820 5; ISBN 0340 80820 9: 119.

7. Hussain T, Fazal M A, Ahmed A, et al. Nosocomial Infection- A Cross-sectional study in surgical wards of Dhaka Medical College Hospital, 1991, December: 10(2); 70–73.

8. Journal of preventive and social medicine. Nosocomial infection- A cross-sectional study in the surgical wards of Dhaka Medical College Hospital; volume 10; No 2; December 1991; ISSN 1012–8697: 70.

9. Meers PD, Ayliffle GAJ, Emerson AM, et al. Report of the nation survey of infection in hospital. J Hospital Infection1980; (Supplement).

10. Ortona L, Federico G, Fantonim, et al. A study on the incidence of nosocomial infection in a large University Hospital Eur J Epidemiol 1985; 1 (2): 94–95.

11. Ayliffle G A J, Gollins B J, Taylor L J. Hospital acquired infection. London: Boston John Wrist and Sons Ltd., 1982; 17–125.

12. West JCN, Legace MB, Mitchal MA. Hospital acquired infection: Present and future impact and need for positive action. Can Med Assoc J 1974; 110: 769.

13. American Hospital Association. Infection control in the hospital, Chicago 1968:32.

14. Bailey and Love's. Short practice of surgery. Wound infection; 24th edition; 2005; ISBN 0340 80820 5; ISBN 0340 80820 9: 125.

15. Cohen IK, Diegelmann RF, Lingblad WJ. Wound healing. Biochemical and chemical aspects. W.B. Saunders, Philadelphia, PA, 1992.

16. Davis JM, Shires GT. Principles and management of surgical infections. J.B. Lippincott, Philadelphia, PA, 1991.

17. Raymon LP. USMLE step 1 Pharmacology; Pharmacokinetics: 12–14.

18. Howard RJ, Simmons RL. Surgical infectious diseases, 2nd edn. Appleton and Lange, Norwalk, CT, 1998.

19. Bailey and Love's. Short practice of surgery. Wound infection; 24th edition; 2005; ISBN 0340 80820 5; ISBN 0340 80820 9: 122.

20. Leaper DJ, Harding KG. Wound: Biology and management. Oxford Medical, Oxford, 1998.

21. Majno G. The healing hand. Man and wound in ancient world. Harvard University Press, Cambridge, MA, 1977.

22. Bailey and Love's. Short practice of surgery. Wound infection; 24th edition; 2005; ISBN 0340 80820 5; ISBN 0340 80820 9: 131.

23. Taylor EW. Infection in surgical practice. Oxford Medical, Oxford, 1992.

24. Bailey and Love's. Short practice of surgery. Sterile precautions and theatre safety; 24th edition; 2005; ISBN 0340 80820 5; ISBN 0340 80820 9: 133.

25. Bailey and Love's. Short practice of surgery. Sterile precautions and theatre safety; 24th edition; 2005; ISBN 0340 80820 5; ISBN 0340 80820 9: 133.

26. Microsoft ® Encarta ® 2008. © 1993-2007 Microsoft Corporation. All rights reserved.

Received March 9, 2009.
Accepted January 28, 2011.