Research Article

Study of effects of different methods of pre-operative skin preparation on post-operative wound infection

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Abstract This study was carried out in 150 cases to make a comparative study of different methods of preoperative skin preparation to find out the best possible and feasible method out of the many available methods influencing the rate of postoperative surgical site infection.
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INTRODUCTION

Postoperative wound infection rate rises with increasing age of the patient Postoperative wound infection rate was not significantly affected by sex (male or female).Only patients with optimum health were selected, to get better platform on which different pre-operative skin preparation methods can be particularly studied, in relation to wound infection. Wound infection rate is more common with shaving, particularly when it is done 24 hours prior to surgery, most probably due to trauma inflicted on skin of operative site and resultant bacterial access and growth – which will be obviously more when duration between preoperative preparation and operation is more. Applying depilatory cream was handy, easy with good hair removal, more acceptable over sensitive and irregular areas, may be used by even patient himself, non-toxic but slightly costlier. Wound infection rate is much less when hair removal is done using depilatory creams just prior to surgery since it avoids trauma to the skin and subsequent bacterial colonisation. Wound infection was least common when painting is done with povidone iodine solution. Increasing concentrations of solution are available (5%, 7.5% and10%). But 5% solution is found to be most effective as optimal required concentration of free iodine which has microbiocidal activity is available in 5% dilution of povidone iodine. It was non-irritant, easily applied and removed, delineates operative area and can be used over tender skin e.g. scrotum. Wound infection rate was roughly equal in other groups slightly favouring hibitane. Wound infection rate increases as duration of surgery increase. Indications and necessity for putting drain are know, but wound infection rate was found to be increased when drain is put. Vascular surgery and oncosurgery carries high risk for wound infection while minimal invasive surgeries are associated with low rates of infection. Hospital stay when neutralised by other confounding factors does not appear to affect the infection rate much significantly. Bacteriological study was tried as an another parameter for effectiveness of skin preparation. It showed efficacy of all antiseptics. Staphylococcus aureus was the most common pathogen in infected wounds.

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MATERIALS AND METHODS

To make this study, randomised prospective study of 150 cases which were admitted and operated at our hospital during December 2009 to October 2010 were included.

CRITERIA FOR CASE SELECTION

Only those cases that undergo clean and elective operations were included in the study. Definition of clean wound: It includes those wounds in which gastro-intestinal, genitourinary and respiratory tracts are not entered; in which no apparent inflammation encountered and in which no break in aseptic technique occurred

Inclusion Criteria

- All age groups
- Both sexes
- Routine and non-infected operations are included
- Cases with optimum preoperative health conditions only are included

Exclusion Criteria

- Septic operations
- Conditions likely to affect wound healing such as severe malnutrition, morbid obesity, uncontrolled diabetes mellitus, uremia etc.
- Local skin disease/wound; allergy to any drug or antiseptic solution

SUBJECT RECRUITM ENT PROCEDURE

Total 150 subjects shall be enrolled. Batches of 30 subjects shall be allocated to each antiseptic painting method; and in each method of hair removal shall be chosen randomly using blinded chits but equally (6 out of 30 in each method). After completing a batch of 30 for particular antiseptic solution, next batch shall be allotted another solution and so on.

OBSERVATION AND RESULTS

Table 1: Age incidence of infected cases

Age in yrs	1 to 14	15 to 24	25 to 44	45 to 64	65 or More	Total
Infected Cases	3	1	9	16	7	36
Non-infected Cases	9	9	28	40	28	114
%infected Cases	25	10	24.32	28.57	20	24
Total Cases	**12**	**10**	**37**	**56**	**35**	**150**

Table 2: Sex incidence of infected cases

Sex	Male	Female
Infected Cases	26	10
Non-infected Cases	73	39
%infected Cases	25.74	20.41
Total Cases	**101**	**49**

Table 3: Investigations parameters of infected cases

Parameters	All	Infected Cases	Non-infected cases
BMI	25.89	28.13	25.2
Hb (g%)	11.612	9.27	12.2
BUN (mg%)	30.33	37.8	27.9
FBS (mg%)	114.16	138.3	106.54

Table 4: Incidence of infections in different operations

Name of the Operation	Infected Cases	Total Cases	%Infected cases
Spine surgery	1	4	25
Av Fistula	3	5	60
BCS	1	4	25
Benign Breast Surgery	0	10	0
Arterial Bypass Surgery	4	7	57.14
Open Cholecystectomy	1	2	50
Craniotomy	2	8	25
Subcutaneous Swelling Excision	1	5	20
Ventral Hernioplasty	8	16	50
Herniotomy	0	4	0
Hydrocele Surgery	1	2	50
Groin Hernioplasty	3	33	9.09
Lap Cholecystectomy	2	16	12.5
Lap Groinhernioplasty	0	3	0

Finger Amputation	0	1	0
Flap Surgery	1	3	33.33
Facial bones plating	0	4	0
MRM	5	10	50
Nephrectomy	1	1	100
Orchidectomy	0	3	0
Orchiopexcy	0	3	0
Penectomy	2	2	100
Pubic Exposure	0	1	0
Varicocele Ligation	0	1	0
Varicose Vein Ligation	0	2	0
Total Cases	**36**	**150**	**24**

Table 5: Incidence of infected cases in different groups of preoperative hair removal methods

Groups	S4	S24	D4	D24	Nhr
Infected Cases	5	10	2	6	12
Non-infected Cases	25	20	28	24	18
%infected Cases	16.67	33.33	6.67	20	40

Table 6: Incidence of infected cases in different groups of preoperative antiseptic painting

Painting Groups	P1	P2	P3	H	C
Infected Cases	4	6	9	7	10
Non-infected Cases	26	24	21	23	20
% infected Cases	13.33	20	30	23.33	33.33

DISCUSSION

The present study comprised enrollment of 150 patients admitted in Surgery Department at our hospital, planned to undergo elective clean surgery during the time period of December 2009 to October 2010 to compare various preoperative skin preparation methods and their effect on postoperative wound infection. As is discussed earlier, postoperative wound infection is important cause of perioperative morbidity and mortality, several studies have been conducted in view to understand its incidence, causative factors and effectiveness of various interventions in line of their prevention. The following table depicts the various rates of postoperative wound infection rates as studied by different examiners.

Series	Year	% infection year
NRC	1964	7.5
Seropian-Reynold	1969	2.1
Agrawal Sl	1972	22.5
Cruse-Foord	1973	1.8
Leissner *et al*	1976	2.9
Brote *et al*	1976	3.5
Rajkumar, Mittak Kk	1976	6.1
Cruse Foord	1980	1.5
Cherian Tk	1981	11.5
Harley *et al*	1985	2.9
Ninss Survey	2002	10
Present Study	2011	24

The table shows infection rates in different age groups. As can be seen the incidence of infection rises with age with majority of peak after 45 years. The reasons for infection in elderly are presence of associated systemic disease, decreasing immune resistance; impaired healing properties compared to young age, longer preoperative hospital stay for better preparation also predispose them to infection. Other factors including poor compliance, decreased mobility and appetite also contribute to the same. Usually sex is not regarded as risk factor for wound infection but the incidence is slightly higher amongst males probably because of large population of the studies is formed by males. However associated comorbid diseases and habits like smoking and tobacco are found more in males which may hamper healing in these patients. The table above shows higher postoperative wound infection rate with shavingrazor method, particularly when done 24 hours prior to surgery; similarly highest infection rate was noted in No Hair Removal group. Amongst depilation method groups, hairs removed by using depilatory cream 4 hours prior to surgery show least incidence of postoperative wound infection (6.67%). This does coincide with earlier studies done by Seropian Reynolds and Court Brown. Study performed by Alexander *et al*, in March 1983 compared rates of infection after 30 days comparing shaving with depilation using clipping emphasizing the importance of time of hair removal prior to surgery. The results were:

- Shaving evening before: 8.8%
- Shaving same morning: 10.0%
- Depilation evening before: 7.5%
- Depilation same morning: 3.2%

P.Thur de Koos, B. McComas in March 1983, compared "shaving versus skin depilatory cream for skin preparation as a prospective study", the results showed infection rates:
Shaving: 8.3% Depilation: 7.7%
Literature review of preoperative hair removal made by Norwegian Centre for Health Technology Assessment, Oslo, in 2002 May describes a systematic literature review on hair removal. By searching the electronic databases and reference lists of relevant articles, team members identified 20 clinical studies that deal with hair removal. They concluded that:

- It is not strongly recommended that hair removal results in a higher frequency of SSIs than no hair removal.
- Either wet or dry shaving the evening before the procedure results in a significantly higher infection rate than depilation or electric clipping
- Hair removal with clippers or depilatory creams should be performed as close as possible to the time of the procedure.

Such findings can be explained by the formation of small skin aberrations after shaving using razor that later are infected by multiplying microorganisms. Subsequent surgical incisions in shaved skin, therefore become infected more easily than in untreated skin. (33) Performing hair removal much earlier to surgery allows growth of microorganisms lodged in the micro-lacerations and hence increase in the microbial flora of skin that can later cause wound infection. Depilation does remove hair and leave the follicles open but compared with razor, does not cause lacerations and hence comparatively lower amount of organisms. Not removing hairs before surgery is somewhat inconclusive, but performing surgeries at areas with many hairs, has increased rates of infection, since there are more number of organisms lodged in the hairs than bare skin. Lowest wound infection rate is seen in Povidone iodine group which supports earlier observations made by Connel *et al* (1964) and Close *et al* (1964). Swenson BR, Hedrick TL, in Oct 2009, studied skin preparation using povidone iodine and chlorhexidine. The wound infections rates were 4.8% in povidone iodine group vs 8.2% in chlorhexidine group. Wound infection rates with the rest of the groups are similar with slight differences, favouring chlorhexidine group. In clean operations, the contaminating bacteria are usually from outside (air, OT equipments etc.) or patients own skin. More effective antiseptic, more decrease bacterial inoculums, so less chances of wound infection. Postoperative wound infection rate increases as duration of operation increases, similar to earlier observations by other researchers. This is true in any preoperative skin preparation method used. This may be because the dosage of bacterial contamination of an incision increases with time; because cells are increasingly damaged by exposure to air or to trauma from sponges and retractors; because increased amounts of suture may reduce the local resistance to infection; or because longer procedures are more liable to be associated with blood loss and shock, thereby reducing the patient's general resistance.[1] Longer operative periods are usually associated with more chances of external bacterial contamination and more injury to adjacent tissue, so probably more predisposition to wound infection. Present figures show that postoperative wound infection is increased where postoperative drain is kept, and this is true with any method of skin preparation used (see observation and results, table 8). This is similar to earlier conclusion by N R C (1964) and Cruse Foord (1973). Meleney[49] and Lidwell[50] have noted a higher infection rate in drained than in undrained wounds. In the present series the infection rate for undrained clean wounds was one-third that of drained wounds. Probably drain acts as pathway for in/out of microorganisms which may infect adjacent suture area. There is an increase in infection rate with increasing hospital stay, this observation was also made by the N R C study and the Public Health Laboratory Service Study[51]. The two possible explanations are a lowering of the resistance of the patient and an increase in the bacterial contamination.

CONCLUSION

Despite other factors postoperative wound infection rate was found to vary with different pre-operative skin preparation method, more in shaving group particularly when done before 20-24 hours before operation. Depilatory cream is effective, timesaving, better on irregular sensitive areas and avoided in allergic individuals. Best results are obtained when depilatory cream is used for hair removal just before operation. In antiseptic group, povidone iodine 5% w/v solution painting is effective than rest but slightly costlier.

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