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An observational study on incidence of infection and septicemia in cases of burn at RIMS, Ranchi

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Abstract

Background:- Burns are among the oldest injuries that man still suffers from. In spite of much advancement burn injuries continue to pose significant problem in their occurrence and treatment. As the world is becoming more and more modernized, the incidence of burn is also increasing.

Methods: An observational study was conducted on 31 burn cases admitted in the Department of Surgery, Rajendra Institute of Medical Sciences, Ranchi during the period of April, 2020 to December 2020. Aims of the study to find out the aetiological factors leading to infection and septicaemia in cases of burns and modalities of treatment.

Results: The present study consisted of 31 cases of mixed flame burns TBSA varied from 20% to 60%. Of total 155 isolates, swabs were sterile in 29 incidences, single isolates were found in 92 incidences and multiple isolates were found in 34 incidences. Commonest organism of burn wound sepsis was Ps. aeruginosa (34.19%) followed by Staph. aureus (20.64%, E. coli (18.06%), Proteus (9.03%), Klebsiella (8.39%). Staph. aureus was the commonest organism in 1st week and Ps. aeruginosa was the commonest organism in later weeks. Ps. aeruginosa, E. coli, Proteus, Klebsiella and Staph. aureus were sensitive to Amikacin in 60%, 51%, 57%, 51% and 11% respectively. Ps. aeruginosa was sensitive to Gentamicin in 31% cases.

Conclusion: Commonest organism of infection in case of burns is Ps. aeruginosa. Staph. aureus is the second commonest organism. The most sensitive antibiotic was found to be Amikacin. One antibiotic should not be used for prolonged period, least resistance develops. Antibiotic should be changed from time to time according to culture and sensitivity report done regularly.

Keywords: Burn, sepsis, Staph. Aureus, Ps. Aeruginosa, antibiotics.

Introduction

Burns are among the oldest injuries that man still suffers from. In spite of much advancement burn injuries continue to pose significant problem in their occurrence and treatment. As the world is becoming

more and more modernized, the incidence of burn is also increasing. According to a report from the World Health Organization in 2018, about 11 million burn cases occur annually worldwide, with burn injuries claiming as many as 180,000 lives[1]; looking back to almost a decade ago, mortality from burns has decreased from the 300,000 deaths recorded in 2011[2]. The mortality rate, however, remains unacceptably high, particularly in patients with severe burns.

Scalds, friction, high temperature, cold, chemical, radiation and electricity are the major causes of burn.[2] Nevertheless, thermal injury caused by hot liquids, solids or fire makes up the majority of burn injuries.[4]

Burns predispose to infection and septicaemia by damaging the protective barrier function of the skin thus facilitating the entry of pathogenic micro organisms and by inducing systemic immunosuppression. It is therefore not surprising that infection and septicaemia are the major causes of morbidity and mortality in serious burn injuries.[5]

In no other surgical patient is the problem of infection as great as in the burn patient. Despite the numerous advances over the past two decades that have occurred in fluid resuscitation, metabolic and nutritional support and topical and systemic antibiotic therapy, infection remains the leading cause of morbidity and mortality in victims of thermal injuries.

Since the practice of aggressive fluid resuscitation was implemented, even the most severely burned patient can survive the immediate post burn period. However, bacterial or fungal wound infection rapidly ensues if appropriate prophylaxis is not instituted and culminates in septicaemia and multi organ failure if prompt treatment is not provided when infection occurs.[6]

The commonest, simplest and therefore the frequently used procedure is taking a swab from wound for bacteriological culture. The procedure is cost effective, reliable and the results are known very early compared to other methods. The other methods employed in assessing the microbial flora are wound biopsy and blood culture.

Blood cultures present specific difficulties. Positive cultures provide important information; however negative cultures do not provide assurance that the patient is free of blood borne infection but instead simply demonstrate that the patient was not bacteraemic at the time of culture. Results are additionally confounded by high rate of skin contaminants where the resulting culture is indicative of cutaneous flora rather than the blood. Life threatening sepsis may occur in the absence of septicaemia and presence of bacteria in the blood stream is relatively late phenomenon often just preceding death.

Surface swab for culture and sensitivity is helpful to predict the effectiveness of therapeutic regimen. It is particularly useful in patients receiving skin graft because severe infection may destroy the graft.

In this study we have used the surface swab technique and wherever necessary blood culture technique. Sensitivity of micro organisms to different antibiotics has been determined.

Aims and objectives

The present study was undertaken with the following aims and objectives:

1. To find out the aetiological factors leading to infection and septicaemia in cases of burns.
2. Evaluate the measures to prevent infection and septicaemia in cases of burn.
3. To find out the modalities of treatment of infection and septicaemia in cases of burn and thereby providing the minimal stay cost effective treatment

to such patients.

Materials and Methods

This was an observational study. After getting the permission from Institutional Ethics Committee of RIMS, Ranchi, the subjects were selected from the patients admitted to Burn Unit, Department of Surgery, RIMS, Ranchi during the period of April, 2020 to December 2020. A total of 31 patients examined. Written consent was obtained from each patient.

Inclusion criteria

1. Patients with 15-70% burns.
2. Patients with age group ranging from 0-75 years.
3. They were all admitted with 48 hours of burn.

Exclusion criteria:- Patients with generalised disease like diabetes, hypertension were excluded as they might have adverse effect on wound healing.

Management

1. **Assessment of severity:** Factors determining severity include body surface area involved, depth of burn, anatomical site involved etc. Patient was completely examined with full exposure. History was taken from the patient or attendant.

   BSA was measured according to Wallace's rule of nine or chart of age adjusted BSA in children
2. **Fluid resuscitation:** In our burn unit, RIMS we used Parkland formula for resuscitation.

   = (4 x % BSA x Body weight) ml

Burned patient with more than 20% BSA were routinely catheterized and urine output monitored.

3. **Respiratory Support:** Whenever there is respiratory distress, intermittent oxygen inhalation was used
4. **Correction of electrolyte disturbances:** Serum electrolytes were estimated in some cases and fluids were adjusted as per the report.
5. **Managing the burn wound**: Burn wounds were routinely washed with normal saline and then dressed with silver sulphadiazine ointment.
6. **Administration of antibiotics and tetanus toxoid:** Antibiotics, tetanus toxoid and in some cases tetglobe were given prophylactically.
7. **Nutrition:** Protein rich high calorie diet and blood transfusion as and when needed were advised.
8. **Pain relief:** Inj. Pentazocine i.v. 8 hourly was given to the patient.
9. **Preventing curling's ulcer:** Inj. Ranitidine I ampoule 8 hourly given i.v. to patients.
10. **Investigations:** Hb, TC, DC, Urine R/E, Blood Sugar & Blood Urea done as needed.
11. **Assessment of the wound:** Assessment of the wound was done by examining the floor, edge, discharge and surrounding area.
12. **Wound Bacteriology:** The patients were evaluated clinically and swabs were taken on the 3rd, 7th day and then at weekly intervals for four weeks. Specimens were collected after washing the wound surface free of topical antibiotics with normal saline. The swabs were taken from the area of 2nd degree and 3rd degree burns.
13. **Surface Swab Culture:** A total of 150 swabs were taken during the study from 31 patients including 6 persons who died during the study. Swabs were sent to Microbiology Lab. of RIMS, Ranchi in a sterile test tube.
14. **Antibiotics:** Systemic antibiotics were administered on the basis of sensitivity of bacterial flora.

Results

Table 1: Age incidence

Age Group (years)	No. of Cases	Percentage
0 - 10	1	3.22
11 - 20	6	19.35
21 - 30	14	45.16
31 - 40	8	25.80
41 - 50	1	3.22
51 - 50	1	3.22
61 - 70	0	0.00

Age incidence varied from 1 to 60 years.

45.16% of patients were of age group - 21 to 30 years.

Table 2 : Sex incidence

Sex	No. of Cases	Percentage
Male	10	32.26
Female	21	67.74

32.26% were male patients and 67.74% were female patients. Male Female ratio was 1:2.1.

Table 3: Incidence of TBSA (total body surface area)

TBSA	No.	Percentage
20- 30%	15	48.4
31 -40%	10	32.2
41 - 50%	4	12.9
51 -60%	2	6.5

Incidence of TBSA varied from 20 - 60%.

Table 4 : Incidence of no growth, single isolate or multiple isolates

	On 3rd day	On 7th day	2nd week	3rd week	4th week	Total
No growth	21	5	3	0	0	29
Single isolate	9	11	18	23	31	92
Multiple isolates	3	5	9	11	6	34

Inference

No growth found in 29 incidences

Single isolate found in 92 incidences

Multiple isolates found in 34 incidences

On 3rd day

63.63% showed no growth

27.28% showed single growth

9.09% showed multiple growths

On 7th day

23.81% showed no growth

52.38% showed single growth

23.81% showed multiple growths

At the end of 2nd week

10.00% showed no growth

60.00% showed single growth

30.00% showed multiple growths

At the end of 3rd week

67.65% showed single growth

32.35% showed multiple growths

At the end of 4th week

83.78% showed single growth

16.22% showed multiple growths

Table 5: Incidence of bacteria in the wounds by swab culture

Bacteria	No. of incidences	Percentage
Pseudomonas aeruginosa	53	34.19
Staphylococcus aureus	32	20.64
Escherichia coli	28	18.06
Proteus	14	9.03
Klebsiella	13	8.39
No growth	15	9.69

Total No. of isolates – 155. Commonest organism was found to be Pseudomonas aerugonosa (34.19%). Staph. aureus was isolated in 20.64% of cases. Incidence of

gram negative bacilli was 79.36%.

Table 6: Incidence of isolates in first week

Micro-organism	3rd day	7th day
Staphylococcus aureus	2	5
Pseudomonas aeruginosa	1	3
Escherichia coli	2	2
Proteus	1	2
Klebsiella	1	1

Staph. Aureus was more common in 1st week.

Table 7 : Weekly incidence of isolates

Micro-organism	End of week			
	1st	2nd	3rd	4th
Pseudomonas aeruginosa	4	18	21	23
Staphylococcus aureus	7	6	3	2
Escherichia coli	4	8	10	11
Proteus	3	4	5	3
Klebsiella	2	3	1	2

Staphylococcus was predominant in 1st week. Pseudomonas aeruginosa was commoner in next week.

Table 8: incidence of scanty, moderate and heavy growths

Total No. of swabs studied	No growth	Scanty growth	Moderate growth	Heavy growth
155	15 (9.67%)	61 (39.35%)	54 (34.84%)	25 (16.14%)

Total No. of swabs sent – 155

No growth found in 15 cases

Isolates identified in 140 cases

Incidence of no growth – 9.67%

Incidence of moderate growth – 34.84%

Incidence of heavy growth – 16.14%

Table 9: Antibiotic sensitivity in general

Antibiotic	Incidence of sensitivity and percentage	
Ampicillin	12	7
Cephalexin	38	22
Cefotaxim	62	36
Ceftriaxone	66	38.3
Cefoperazone	61	35
Amoxicillin	33	19
Gentamicin	48	27.5
Amikacin	104	60
Tetracyclin	4	2.5
Ciprofloxacin	54	31.2
Ofloxacin	71	41

Total isolates – 174. Amikacin was the most common sensitive antibiotic. 60% of all isolates were sensitive to Amikacin. Ofloxacin was the 2nd most common sensitive antibiotic with 41% sensitivity. 36% of all isolates were sensitive to Cefotaxim. 35% were sensitive to Cefoperazone. 38.3% and 31.2% of all isolates were sensitive to Ceftriaxone and Ciprofloxacin respectively.

Table 10: Sensitivity of isolates separately to six common antibiotics

Antibiotics	Staph. Aureus (n=51)	Ps. Aeruginosa (n=89)	E. coli (n=41)	Proteus (n=17)	Klebsiella(n=19)
Amikacin	5 (11%)	53(60%)	21(51%)	9(57%)	9(51%)
Gentamicin	8(16%)	27(31%)	9(21%)	5(31%)	6(33%)	
Ofloxacin	21(41%)	43(49%)	22(55%)	6(33%)	7(41%)
Ciprofloxacin	17 (34%)	30 (34%)	14 (33%)	9 (47%)	8 (43%)

Cefotaxim	11(21%)	29(33%)	16(35%)	7(39%)	9(45%)
Cefoperazone	16(31%)	34(38%)	13(31%)	5(32%)	6(33%)

Amikacin was the best antibiotic. Staph aureus, Ps. aeruginosa, E. coli, Proteus and Klebsiella were sensitive to this antibiotic in 11%, 60%, 51%, 57% and 51% respectively. Ofloxacin was the 2nd best antibiotic with sensitivity of Staph aureus, Ps. aeruginosa and E. coli being 41%, 49% and 55% respectively.

Discussion

A total of 31 patients were studied. Their ages ranged from 1 year to 60 years (Table-1).

Out of 31 patients 10 (32.26%) were male patients and 21 (67.74%) were female patients. Male: Female ratio was 1: 2.1 (Table-2).

Total body surface area (TBSA) varied from 20 to 60%. Out of 31 patients, 7 (22.58%) died and 24 (77.42%) survived (Table -3).

Burn wound swabs for culture and sensitivity were taken on the 3rd, 7th day and at the end of 2nd, 3rd and 4th week. On every case the wound was examined clinically. Their general condition was also monitored. According to requirement pathological and biochemical investigations were done.

In this study total of 155 swabs were taken from 31 cases. No growth was found in 29 incidences. Single isolate was found in 92 incidences. Multiple isolates were found in 34 incidences. Monobacterial growths out numbered polybacterial growth during the study.

Commonest organism of burn wound sepsis was Pseudomonas aeruginosa (34.19%) (Table- 5).

Bharadwaj et al (1983)[7] reported only 10.5% Pseudomonas aeruginosa from burn wound. Baxter et al (1973) reported an incidence of 83.76% of pseudomonas in a study of 117 wounds.

Menon et a1 (1984)[8] isolated Pseudomonas 14.28% of cases. D. M. Jackson in his article (1991)[9] mentioned that it was commonest cause of fatal septicaemia in the mid sixties.

Karyote (1989)[10], Daksha Pandit and Madhuri Gore et a1 (1997)[11], Rasteger Lari et a1 (1998)[12] and Nagoba B. S. et a1 (1999)[13] showed relative incidence of pseudomonas aeruginosa of 32%, 53%, 73.9% and 53.8% respectively. My findings are almost identical with Karyote et al.

Streptococcus pyogenes was not isolated in my study. Menon et a1 (1984)[8] and Karyote et a1 (1989)[10] also could not find streptococcus in their studies.

In my study incidence of staphylococci was 20.64% of cases. Incidence of staphylococci was reported to be 28% and 19.4%, by Karyote et al (1989)[10], Atoyebi et a1 (1992)[14] respectively. My study closely resembles with that of Karyote et al. Bhardwaj et al[7], and Menon et a1 (1984)[8] reported incidence of staphylococci to be 41.1% and 53.35% respectively. But though previously staphylococcus was the commonest organism, at present due to aseptic technique and advent of newer potent antibiotics its incidence has been reduced.

In the present study the incidence of E. coli was 18.06%. Bhardwaj et a1 (1983)[7] isolated E. coli in 7.4% cases. Incidence of E. coli was reported to be 15%, 28.57%, 3.2%, 8.5% and 10.7% by Karyote et a1 (1989),[10] Menon et a1 (1984),[8] Atoyebi et a1 (1992),[14] Rastegar Lari et a1 (1998)[12] and Nogaba et al[13] respectively.

My study does not coincide with any of the above mentioned workers. This is because bacterial flora varies from centre to centre in a burn unit.

In my study incidence of proteus was 9.03%. Incidence of proteus was found to be 19.4%, 10%, 18.4% by Atoyebi et al (1992),[14] Karyoute et al (1989).[10] and

Nagoba et a1 (1999)[13] respectively. My finding was similar to that of Karyote et al.

In my study incidence of Klebsiella was 8.39%. Incidence of Klebsiella was found to be 11%, 10%, 27.6%, 26.7% by Karyote et al,[10] Atoyebi et al,[14] Nagoba et al (1999)[13] and Ozumba et al (2000)[15] respectively. My result almost coincides with that of Atoyebi et al.

In my study percentage of gram negative bacilli was 79.36%. Incidence of gram negative bacilli was found to be 58.6%, 68%, 65.5%, by Bhardwaj et a1(1983)[7], Karyote et a1[10] (1989) and Atoyebi et al[14] (1993), respectively. It was noted that gram positive organisms usually predominated during the first week while gram negative organisms dominated in the later weeks.

In total number of 155 swabs sent- incidence of no growth found in 15 (9.67%) cases, incidence of scanty growth in 61 (39.35%) cases, incidence of moderate growth in 54 (34.84%) and incidence of heavy growth in 25 (16.14%) (Table- 8).

Wound infection does not constitute mere presence of bacteria on the surface of the wound. When the advancing front of infection is in the living tissues and not in the necrotic tissue nor in the purulent wound discharge, then only it is referred to as true wound infection. According to Taplitz et a1 (1964)[16] when bacteria cross supraeschar and inraeschar areas and involve subjacent viable tissues, clinical features of burn sepsis appear.

Bacterial count determines the speed of burn wound healing. Wound healing is inversely proportional to the concentration of bacteria.

In the present study the antibiotic sensitivity test reveals the following facts (with reference to Table-9):

60% of all isolates were sensitive to Amikacin. Isolates were well sensitive to ofloxacin, cefotaxim, cefoperazone, ceftriaxone and ciprofloxacin in 41%, 35%, 36%, 38.3% and 31.2% respectively. Table-10 shows the antibiotic sensitivity of isolates separately.

11% Staph. aureus, 60% Ps. aeruginosa, 57% E. coli, 57% Proteus, 51% Klebsiella were sensitive to Amikacin. It is the best antibiotic.

16% Staph. aureus, 31% Ps. aeruginosa, 21% E. coli, 31% Proteus and 33% Klebsiella were sensitive to Gentamicin. Poor sensitivity of Gentamicin to gram negative bacilli could be due to its frequent use in burn ward. 41% Staph. aureus, 49% Ps. aeruginosa, 55% E. coli, 33% Proteus and 41% Klebsiella were sensitive to Oflaxacin. It is the second best antibiotic.

34% Staph. aureus, 34% Ps. aeruginosa, 33% E. coli, 47% Proteus and 43% Klebsiella were sensitive to Ciprofloxacin.

21% Staph. aureus, 33% Ps. aeruginosa, 35% E. coli, 39% Proteus and 45% Klebsiella were sensitive to Cefotaxin.

31% Staph. aureus, 38% Ps. aeruginosa, 31% E. coli, 32% Proteus and 33% Klebsiella were sensitive to cefoperazone.

In three cases it was found that the organisms developed resistance to drugs to which they were sensitive initially. Though these cases were sensitive initially to Amikacin and Ofloxacin, later on they developed resistance. These Patients however responded well to cefoperazone.

Surprisingly the micro organisms showed high degree of sensitivity to chloramphenicol. This happened because chloramphenicol is now rarely used in burn unit.

Ofloxacin and ciprofloxacin differ from Nalindixic acid by having broader antibacterial spectrum. Ofloxacin inhibits majority of gram negative bacilli and highly effective in Pseudomonas infection. By 1983

gentamicin became available and had become the most effective systemic antimicrobial against Ps. aeruginosa, E. coli & Klebsiella. But by 1989 it became more or less resistant due to frequent use.

Thorough, bacteriological surveillance should be done in all burn centres. Antibiotic should be used empirically when clinical sign of wound infection or septicaemia develop according to antibiotic sensitivity status of the centre till the bacteriological report came.

Gillet (1985)[17] suggested that antibiotic therapy of septicaemia or wound sepsis is best achieved by systemically using maximum doses.

Lawrence (1987)[18] commented that results with ceftazidime and ciprofloxacin are encouraging.

In 1960 Staphylococcus aureus was considered to be the major cause of hospital infection. With the advent and increasing use of B-lactum antibiotics gram negative organisms became more prevalent in 1970 and 80's. Indiscriminate use of broad spectrum antibiotics once again has reversed the process and Staphylococcus aureus has once again become leading pathogen causing wound sepsis and septicaemia in burn patients (Pandit and Madhuri et al, 1997).[11]

Multidrug resistance was observed among common microbial flora in burn unit (Ram S, Gupta, R et al, 2000).[19] Restriction in the misuse of antibiotics and establishment of an infection control unit will help to lower the incidence of infection (Ozumba et al, 2000).[15]

The widespread use of broad Spectrum antibiotics have not only increased emergence of resistant organisms in the hospital environment but also changed the sensitivity pattern of the common nosocomial pathogens. Routine use of antibiotics is to be highly condemned.

Measures to prevent burn wound sepsis -

i. Prophylactic antibiotics should not be given to patients below 20% of TBSA.
ii. The antibiotics should be given only on clinical suspicion of sepsis first of all empirically and then adjusted as per antibiogram.
iii. Short term antibiotics should be given perioperatively.
iv. Strict hand washing should be enforced before and after handling each patient and number of attendants should be restricted.
v. Masks should be worn by medical personnel. Screening of their anterior nares should be carried out. If positive, appropriate treatment should be given.
vi. Separate dressing packages should be prepared for individual patient to reduce cross-infection among patients.

In general, prophylactic systemic antibiotics have no role in the management of burn wounds (except for minor burns in out patients) and can in fact lead to colonisation with resistant micro-organisms. An exception involves cases requiring burn wound manipulation. Since procedures such as debridement, excision or grafting frequently result in bacteraemia, prophylactic systemic antibiotics are administered at the time of burn wound manipulation; the particular agents used should be chosen on the basis of data obtained by wound culture or data on the hospital's resident flora.

Conclusion

Unnecessary and indiscriminate use of systemic antibiotics has not only increased the problem of drug resistance but also has changed sensitivity pattern of common infecting organisms. Staph. aureus has shown increased resistance to penicillin, cephalosporin and Gentamicin which are frequently used in burn units

whereas it has shown significantly increased susceptibility to ofloxacin, chloramphenicol. Remarkably a large number of organisms are now sensitive to chloramphenicol probably due to its restricted use in burn units. In brief, commonest organism of infection in case of burns is Ps. aeruginosa. Staph. aureus is the second commonest organism. The most sensitive antibiotic was found to be Amikacin. One antibiotic should not be used for prolonged period, least resistance develops. Antibiotic should be changed from time to time according to culture and sensitivity report done regularly. With destruction of the integrity of the skin, ciliated epithelium and intestinal mucosa, the burn patient is at a distinct risk for local and systemic infection. Management, therefore, is aimed at prophylaxis, surveillance and aggressive management of documented infection. Recent application of these principles has demonstrated a marked decrease in the mortality and morbidity related to wound infections in the thermally injured patient.

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