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Original Research Article

Epidemiology of burn wound infection and its antibacterial resistance, burn registry program

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Abstract

Study of burn flora is helpful in determining current antibiotic susceptibilities and also helpful in locating development of multidrug resistant bacterial strains among the unit's usual flora. Now-a-days the epidemiology of burn wound infections as well as the definitions of burn wound infection, burn wound sepsis and septic shock have changed due to important changes in its treatment. In this study we were to determine the bacteriological pattern of burn wound infections and describe their sensitivity to antibiotics. We used data of our Burn registry program. This is a prospective study, March 2009 to March 2011. All of data about demographic data, age, sex, burn wounds and burn wound infection, Bacteria isolated, sensitivity to different Antibiotics, Burn wound culture, sputum culture, urine culture and catheter tip culture were recorded. Antibiotic susceptibility was determined with the agar disc diffusion method. Statistical analysis was performed with SPSS Version 19 (Statistical Package for the Social Sciences) software. During this study we had 1721 admitted burn patients. The mean age was 26.3 +/- 20.25. Mean hospital stay was 14.41 days (range 0-64 days). Mean (SD) of TBSA was 16.48 (20.67) years; the mortality rate was 5.9 %, Burn wound infection was present in (38.54%). The most frequent sepsis were Staphylococcus spp. (55.1%) and, Pseudomonas aeruginosa (14.29%), Entrococus (12.24%), E coli (4%), Klebsiella and proteus (each one 2%). Positive urine cultures were in 27.9%, positive sputum cultures were in 1.14%, positive catheter tip cultures were in 12.3% and positive blood culture were in 7.6% of the cases. There was correlation between positive wound and blood and urine cultures. Strict and rigorous application of hygiene rules, early wound dressing , early debridement, together with continuous epidemiological surveillance of burn wound bacteria, are important to optimize burn wound infection prevention and treatment and empiric antibiotic therapy.

Keywords: Antibiotic, Bacteriology, Burns, Complication, Early excision, Resistance

INTRODUCTION

Burns are one the major trauma in our country and every year we face more and new cases of burn injury in the country. Burn wounds lack the epidermis and lack the circulation so they are the best culture media with 37 C temperature and are a very good place for bacteria to grow.

A few hours after the burn, wound surface become contaminated with many bacterial flora and they will start

to grow and multiply (Essayagh et al., 2014).

Some of these bacteria are more virulent and have enzymes to dissolve their way to the normal tissue and also some of them have flagella and good motility to pass through the necrotic tissue and reach to the normal soft tissue. By motility and enzyme dissolvement they will reach to vessels and start to disperse. From this point bacteremia and sepsis start (Essayagh et al., 2014; Sewunet et al., 2013).

Burn patients due to release of several cell mediators, have deficiency in immune system and cannot tolerate this invasion. In this way septic shock and most probably death will result.

In order to prevent this scenario, the physicians have to know about pathophysiology of the burn wound infection and flora that most frequently invade the burn wounds. And also the antibiotic sensitivity of the bacteria to treat the patients. One the major concerns is about the treatment of these cases, time of treatment and their outcome too.

In this study we report the most frequent bacteria and their sensitivity in different culture of the burn patients. We used the data of our burn registry program**.**

MATERIALS AND METHODS

We prospectively gathered the data of our burn patients in burn registry program of our country and inserted the data in a special questionnaire with age, sex, demographic data, the length of time from injury to medical care or hospital, accompanying traumas, previous medical history and illnesses, and place of burn, anatomic distribution of burn, seasonal variation, cause of burn , ignition of clothing, mode of extinguishing the fire, extend of 3rd and 4th degree burn, previous clinical condition, any treatment for burn at home, medical staff pre-hospital care, serum therapy before hospital, length of hospital stay, mode of therapy and operative intervention, infection, culture of burn wounds, Culture of urine and sputum and blood and catheter tips, result of Antibiotic sensitivity tests, Antibiotics that were used, result of treatment, Lab tests, percentage of burn (TBSA), complications and outcome of them. Follow up was more than 3 years. The correlation of the results of different culture was also examined. Antibiotic susceptibility was determined with the agar disc diffusion method.

The results were analyzed with SPSS 19 software and p values less than 0.05% was considered significant.

RESULTS

We had 1721 burn patients during more than 2 years who were admitted to the hospital.

Burns caused by open flame were the most frequent (49.8%) followed by scald (35.7%). Among flame burns, propane gas was the most frequent cause 59.7% and then gasoline 24.8%.

The most frequent age group was 25-34 years (20%). Sixty three percent of our patients were male and 37% female .Male to female ratio was 1.7:1.

Table 1 shows the mode of burns whether intentional or accidental.

Mean (SD) of age was 26.3 (20.25).

Mean (SD) of TBSA was 16.48 (20.67)

Mean hospital stay was 14.41 +/- 10.91 days (range 0-64 days).

Mean +/- SD of ICU stay was 6.07+/- 3.58 days

The median hospitalization stay (LOS) was 11 days (S.D. = 10.91, mean = 14.41). Length of stay increased in accordance with burn area ($p<0.02$).

Most of patients who were in 4 hours distance to a hospital with burn care facility had been given good and enough fluid therapy and good resuscitation from the burn shock . And 29% cases had taken fluid therapy before reaching to hospital.

For 539 patients Amnion membrane were used as a temporary cover.

Skin graft surgery was done in 978 (67.26%) of the patients.

In our patients 47.7% cases developed signs of infection in Burn wound.

And burn wound biopsy and tissue culture was done for them. Of them 481 (38.54%) patients had positive culture results.

The most frequent Bacteria that were found in burn wound culture were: Staphylococcus spp. (55.1%) and, Pseudomonas aeruginosab (14.29%), Entrococus (12.24%), E coli (4%), Klebsiella and proteus (each one 2%). (Table 2)

Positive urine cultures were in 27.9%, positive sputum cultures were in 1.14%, positive catheter tip cultures were in 12.3% and positive blood culture were in 7.6% of the cases (Table 3)

There were correlations between positive wound and blood and urine cultures.

The most frequent Antibiotics that were prescribed according to sensitivity tests were: Amikacin (91.9%), Ceftazidim (60.5%) and Meropenem (37.7%). Imipenem (23.3%), Tazobactam (21%), Ciprofluxacin (38.5%)

Cefopime (22.6%), Vancomycin (19%)

About 5.9% of the patients died, 3.9% discharged by their own request (against physician advice), 82.5% of the patients discharged with partial recovery (need further treatments) and 7.4% with complete recovery.

Seventy-two percent of the burn-related deaths were in patients suffering from a burn area of 40% and above.

Table 1. Intention of burns

Intention of burn	frequency	percentage
Suicide	107	6.2
Burning others	5	0.3
Accident	1595	92.7
Unknown	14	0.8
TOTAL	1721	100

Table 2. Frequency of Bacteria isolated from burn wound infections

Bacteria	Percent
E coli	4.08%
Klebsiella	2.04%
Proteus	2.04%
Pseudomonas	14.29%
Staph. Coagulase negative	55.1%
Staph. Aureus	2.%
Strep.	2.%
Entrococcus	12.24%
Others	4.21%
Total	100%

Table 3. Positive cultures in Different organs in burn patients

Organs:	Percentage of positive results
Urine	27.9%
Sputum	1.14%
Catheter tip	12.3%
Blood	7.6%

DISCUSSION

Burn injuries are one of the major traumas in our country and it occurs in more than 100,000 patients every year. Of these, about 6-8% is admitted to specialized burn centers and /or general hospitals.

Burn wounds are good media for bacterial growth. And soon after burn injury colonization happens and bacteria grow more and more and some of them that are more virulent will go deep to the Eschar tissue and will produce some small abscesses below the Eschar.

In this area, there is not host defense and after increasing in number, the bacteria will go to the normal surrounding tissue and then invade lymphatic tissue and then blood vessels, specially venous vessels (Essayagh et al., 2014).

Then bacteriemia will ensure and sepsis and septic shock will happen. Seeding of other tissues and organs also will occur such as in lung tissue, kidney and bladder, heart and its valves, brain and so on (Essayagh et al., 2014).

It is obvious that the most frequent site of infection in burn patients is burn wound and after that lung and kidney and cardiac valves.

Controlling the flora of bacteria in the burn wound and prevention of burn wound infection will result in prevention of many infections in body and prevention of septic shock. Therefore it is important to know about normal and prevalent flora of the burn wounds and bacteria which most frequently produce wound infection. In this way physicians can control the infection in the body and prevent unwanted and worse complications in burn patients.

There are some reports that the most prevalent bacteria in burn wounds are Pseudomonas Aeroginosa. (Turner et al., 2014; Essayagh et al., 2014; Azzopardi et al., 2014; Dou and Zhang, 2014; Cornelis and Dingemans, 2013; Lee et al., 2013; Tekin et al., 2013; Naqvi and Naqvi, 2013; Nanvazadeh et al., 2013; Faezi et al., 2014; Li et al., 2013; Elmanama et al., 2013; Vural et al., 2013).

And some other reports emphasize on prevalence of Staph. aureus in burn wounds (Alrawi et al., 2014; Fekih et al., 2014; Sewunet et al., 2013; Orban and Tomescu, 2013; Belba et al., 2013). Also there are some reports from other bacteria such as Acinetobacter Baumanii which are more prevalent (Beige et al., 2014; Tekin et al., 2014).

However in our study the most frequent bacteria was Staph. Coagulase negative.

It is accept that after the burn injury, the wound is sterile but after a few while, it will be contaminated and colonization can be seen after one day in 33% of the cases, after 7 days in 94% and finally after 2 weeks in 100% of the wounds (Coetzee et al., 2013). In other report from Albania in 2013, colonization had been seen in 43% of the cases and most prevalent bacteria were Staph. 67% and Pseudomonas 24% (Belba et al., 2013).
In the turkey, it was reported that 48.1% cases were colonized and cultures were positive (Vural et al., 2013).
In a report from Gaza, in 2013 45.8% cases were culture positive (Elmanama et al., 2013).
In 2013 there is a report from Rumania that first sign of infection will be seen in first 2 weeks of injury in 97% of cases. Among them 58% are Gram positive and 26% Gram negative bacteria (Orban and Tomescu, 2013).

In these patients Staph. Were 32% and Pseudomonas Aeroginosa 21%.
Teckin et al in 2014 examined the risk factors of infection in burn wounds, and they mentioned; the day of first excision, using invasive devices, delay in hospital admission more than 24 hours, delay in dressing and local treatment of burn wound, previous use of broad-spectrum Antibiotics. TBSA more than 15% are the risk factors of wound infection (Alrawi et al., 2014; Sewunet et al., 2013; Tekin et al., 2014). Delay in local irrigation with chlorhexidine is also mentioned as a factor for burn wound infection (Coetzee et al., 2013).

Some of the infections are from bacterial translocation from small intestine and some of them are airborne (Bache et al., 2015).
For prophylaxis and treatment of burn infection it is said that prophylactic Antibiotic is not necessary and even it may worsen the situation (Chahed et al., 2014).

But other measures has been mentioned such as; early debridement, frequent local irrigation, using H_2O_2, using geranium oil , using Honey, topical Antibiotics, Biofilm disrupting agents, using plastic wrap, Acetic acid, and early excision and skin grafting (Brisbois et al., 2014; Tekin et al., 2014; Faezi et al., 2014; Burlando and Cornara, 2013; Sienkiewicz et al., 2014; Coetzee et al., 2013; Liao et al., 2014; Nagoba et al., 2013).

In unfortunate situations when infection happens, it may find its way to other tissues and organs (Vural et al., 2013; Malone et al., 2013; Sewunet et al., 2013; Lee et al., 2013; Li et al., 2013; Dou and Zhang, 2014). And more invasive infection has been seen in the day 7 after the injury (Taneja et al., 2013).

So it is better to diagnose the infection in advance and begin to treat it. For diagnosis surface swab culture and tissue culture has been recommended (Sewunet et al., 2013; Vural et al., 2013).
Tissue culture is more accurate but swab culture is more rapid and is better to be used in first few days after the injury (Alrawi et al., 2014).
Concordance of positive swab culture and tissue culture is reported to be about 78% (Alrawi et al., 2014).

And most of the cases are from infection with Pseudomonas Aeroginosa.

It is reported from Korea that with time and using Antibiotics, the content of infection with Pseudomonas was reduced but the content of infection with Klebsiella will be increased (Lee et al., 2013).

In our study 38.5% of the patients had positive burn wound tissue culture and most frequent bacteria was Staph. Coagulase negative. But most prevalent bacteria that disseminated through lymph and blood vessels were Pseudomonas Aeroginosa and positive culture in urine and blood and sputum had been detected. In a report from Turkey, Vural et al mentioned that most frequent bacteria disseminated was Pseudomonas and positive culture in urine was 27.9% and blood 7.6% and sputum 1.14% (Vural et al., 2013). In other report from UK the most disseminated bacteria was Staph. (79%) (Alrawi et al., 2014).

In Ethiopia the most disseminated bacteria was Staph. (42.8%) (Sewunet et al., 2013).
In Korea the most one was Pseudomonas 30.1% in burn ICU patients (Lee et al., 2013).

The worst thing about infection with these bacteria in burn centers is that they are Multiple resistant to several Antibiotics and very hard to treat (Sewunet et al., 2013; Tekin et al., 2013; Beige et al., 2014; Azzopardi et al., 2014; Liu et al., 2014; Dou and Zhang, 2014; Estahbanati et al., 2002).

In our study the most sensitive Antibiotics were Amikacin (91.9%), Ceftazidim (60.5%) and Meropenem (37.7%). There are some reports that resistance to Ciprofluxacin and Amikacin are low and during the time will decrease. 5

Identifying the most frequent bacteria in burn wound infections and their resistance to Antibiotics and knowing the new modalities for their treatment is the keystones in preventing disseminated infections and mortality in burn patients.

CONCLUSION

Knowledge of frequent bacterial flora in the burn wounds and methods for prevention and treatment of burn wound infection is one of the first steps in burn wound care.

The most frequent disseminated bacteria in our center was Pseudomonas Aeroginosa and most sensitive Antibiotic was Amikacin. .Early excision and early skin grafting is one of the best treatment for prevention of infection. It will result in early go back to work, minimal length of unemployment and minimal financial burden to patients and their employers.

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