Egypt. Acad. J. biolog. Sci., 3(1): 19-25 (2011) **G. Microbiology**
Email: egyptianacademic@yahoo.com **ISSN: 2090-0872**
Received: 20/5/2010 **www.eajbs.eg.net**

Microorganisms Associated With Burn Wound Infection in Sana'a, Yemen

Alghalibi, S. M. S.; Humaid, A.A.; Alshaibani, E. A. S. and Alhamzy, E. H. L
Biology Department, Faculty of Science, Sana'a University, Sana'a, Yemen.

ABSTRACT

Burn wound infection is a major complication in burn patients after initial period of shock. More than 70 % mortality in burn patients is attributed to infection. This study was conducted from July 2008 to February 2009 at Teiba Center for Burns Surgery in Al-Jumhory Hospital located in Sana'a city, Yemen. A total of 200 burn wound swab were collected. Fifty eight (58%) of patients were males and forty two (42%) were females. The most common age group was ≤ 10 years group (42%), (84.5%) had second-degree burns, (13%) had third-degree burns, (1.5%) had fourth-degree burns and the remainder had first-degree burns, (69.5%) were due to flame, (24.5%) were due to scalds, (4.5%) cases were due to electrical burns and three cases were due to chemical burns. Out of 167 positive cultures, single Gram positive bacteria were the most dominant (44.3%), followed by Gram negative bacteria (28.7%) and mixed Gram positive and Gram negative bacteria (20.4%). *Staphylococcus aureus* was the most common organism, isolated 100 (47.8%), followed by *Pseudomonas aeruginosa* (23%), *Candida albicans* (5.3%), *Escherichia coli* (5.3%), *Serratia plymuthica* (3.8%), *Proteus mirabilis* (2.9%), *Salmonella* species (2.4%), *Staphylococcus epidermidis* (2.4%), *Acinetobacter* species (1.9%), *Streptococcus faecalis* (1.4%), *Bacillus* species (0.96%), *Citrobacter freundii* (0.96%), *Klebsiella* species (0.96), and *Streptococcus pyogenes* (0.96%).

Keywords: Microorganisms- Burn Wound Infection - Yemen

INTRODUCTION

Burn is a thermal injury of the skin, although electrical and chemical injuries may also result in burn (Ekrami and Kalantar 2007). Thermal injury destroys the physical skin barrier that normally prevents invasion of microorganisms. During the first weeks following thermal trauma, the affected sites are colonized with bacteria (Song *et al.,* 2001). Following colonization, these organisms of the surface start to penetrate the burn eschar to available extent and viable sub eschar tissues become invaded (Nasser *et al.*, 2003 and Agnihotri *et al.*, 2004).

It is now estimated that about 75% of the mortality following burn injuries is related to infections. The pattern of infection differs from hospital to hospital; the varied bacterial flora of infected wound may change considerably during the healing period (Rajput *et al.,* 2008). When a hole is created on the skin, microorganisms, usually the opportunistic organisms, invade the holes and multiply leading to a delay in the healing process and finally infectious condition. The spectrum of infection ranges from asymptomatic colonization to bacteraemia and death (Abubakar, 2009).

The common pathogens isolated from burn wound are *Staphylococcus aureus* (75%), *Pseudomonas aeruginosa* (25%), *Streptococcus pyogenes* (20%) and various coliform bacilli (5%). In Iran, Shakibaie *et al.,* (2008) found that 77 (64.2%) out of 120 burn infection patients were males while 43 (35.8%) were females. Most of the burn infection patients aged between 11 to 20 years old. In Kuwait out of 1415 burn patients, 102 of them had developed clinically and microbiologically proven septicemia (Ahmad and Iranzo 2003). In

North America and Europe, acid burns are generally regarded as uncommon industrial accidents and they are rarely associated with assault (Mozingo *et al.*, 1988).

The aim of this study is to isolate and identify microorganisms that associated with burn infection in Teiba Center for Burns Surgery in Al-Jumhory Hospital located in Sana'a city.

MATERIALS AND METHODS

This study was carried out on 200 pus swabs obtained from 200 burn wound patients at Teiba Center for Burns Surgery in Al-Jumhory Hospital located in Sana'a city. The age of the studied burn patients ranged from new born (5 months) to over 60 years old. Each specimen was inoculated Aseptically on sterile Blood agar (Oxoid-England), MacConkey Agar (Oxoid-England) and Sabouraud's Dextrose Agar (Himedia-India). Blood Agar and MacConkey Agar plates were incubated aerobically for 24 hours at 37 °C for the bacteria and Sabouraud's Dextrose Agar media plates were incubated aerobically for 24-48 hours at 25 °C for the fungi. Specimen of third degree burns were inoculated on Clostridium Agar (Oxoid-England) and Blood Agar and incubated anaerobically for 75 hours at 37 °C for the anaerobic bacteria. Bacterial colonies were identified by colony morphology, biochemical test and diagnostic test. Yeast colonies were identified by some diagnostic tests such as colony morphology, Gram stain and germ tube test (Cheesbrough, 1984 and Garrity *et al.*, 2005).

RESULTS

This study indicates that 116 (58%) were males and 84 (42%) were females (Figure 1). Overall, the most common age group was the ≤ 10 years group 84 (42%) in both males and females (Table 1).

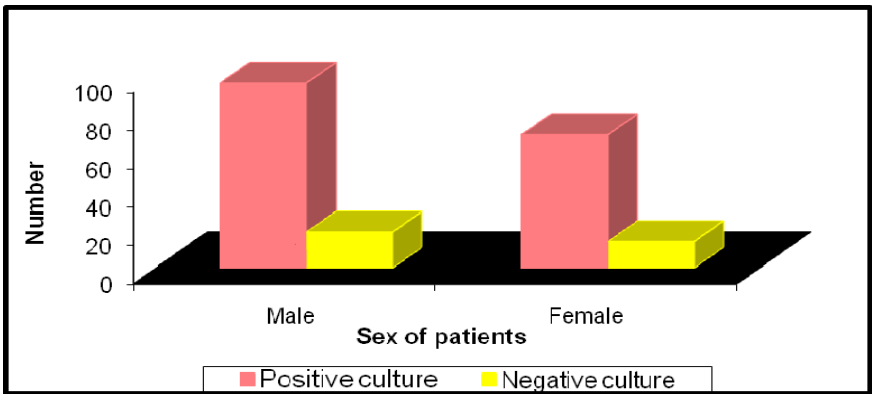

Fig. 1: Distribution of the burn patients according to the sex of patients and culture results.

Table 1: Distribution of the burn patients according to the age groups and culture results.

Age groups	Positive culture		Negative culture		Total		RR	CI95	X^2	P-value
	No	%	No	%	No	%				
≤ 10	66	78.6	18	21.4	84	42	1.1	0.84-1.4	0.4	0.5
10-19	35	83.3	7	16.7	42	21	1.5	1.2-1.9	7.7	0.005
20-29	24	96	1	4	25	12.5	0.84	0.6-1.3	0.74	0.38
30-39	14	66.7	7	33.3	21	10.5	0.37	0.13-1	7.3	0.006
40-49	12	92.3	1	7.7	13	6.5	0.9	0.5-1.6	0.19	0.66
50-59	6	100	0	0	6	3	0.6	0.2-1.8	1.3	0.25
≥ 60	9	100	0	0	9	4.5	0.8	0.4-1.6	0.5	0.47
Total	167	83.5	33	16.5	200	100	-	-	-	-

Relative Risk; X^2= Chi square; CI= Confidence Interval 95% Chi square (X^2) ≥ 3.7, *P*-value ≤0.05 (significant).

In Sana'a city most of the burn patients had second-degree burns 169 cases (84.5%), followed by patients with third-degree burns 26 (13%), 3 (1.5%) had fourth-degree burns and the remainder had first-degree burns (Table 2).

Table 2: Distribution of the burn patients according to degree of burn and culture results

Degree of burn	Positive culture		Negative culture		Total		RR	CI	X^2	*P*-value
	No	%	No	%	No	%				
First- Degree	1	50	1	50	2	1	0.6	0.2-2.4	1.65	0.19
Second-Degree	138	81.7	31	18.3	169	84.5	0.87	0.8-0.9	2.7	0.1
Third- Degree	25	96.1	1	3.9	26	13	1.2	1.1-1.3	3.5	0.06
Fourth- Degree	3	100	0	0	3	1.5	1.2	1.13-1.3	0.6	0.43
Total	167	83.5	33	16.5	200	100	-	-	-	-

RR= Relative Risk; X^2= Chi square; CI= Confidence Interval 95% Chi square (X^2) ≥ 3.7, *P*-value ≤0.05 (significant).

Table 3 showed that out of 200 burn patients included in this study, 139 (69.5%) were due to flame, 49 (24.5%) were due to scalds, 9 (4.5%) cases due to electrical burns and three cases due to chemical burns**.**

Table 3: Distribution of the burn patients according to the cause of burn and culture results.

Cause of burn	Positive culture		Negative culture		Total		RR	CI	X^2	*P*-value
	No	%	No	%	No	%				
Flame	117	84.2	22	15.8	139	69.5	1	0.9-1.2	0.15	0.69
Scalds	41	83.7	8	16.3	49	24.5	1	0.9-1.2	0.00	0.96
Electrical	6	66.7	3	33.3	9	4.5	0.8	0.5-1.3	1.94	0.1
Chemical	3	100	0	0	3	1.5	1.2	1.1-1.3	0.6	0.43
Total	167	83.5	33	16.5	200	100	-	-	-	-

RR= Relative Risk; X^2= Chi square; CI= Confidence Interval 95% Chi square (X^2) ≥ 3.7, *P*-value ≤0.05 (significant).

Out 167 positive cultures, single Gram positive bacteria were the most dominant (44.3%), followed by Gram negative bacteria (28.7%) and mixed Gram positive + Gram negative bacteria (20.4%). *Staphylococcus aureus* was the most common organism isolated from burn wound infection in Sana'a city 100 (47.85 %), followed by *Pseudomonas aeruginosa, Candida albicans* (5.3%), *Escherichia coli* (5.3%), *Serratia plymuthica* (3.8%), *Proteus mirabilis* (2.9%), *Salmonella* species (2.4%), *Staphylococcus epidermidis* (2.4%), *Acinetobacter* species (1.9%), *Streptococcus faecalis* (1.4%), *Bacillus* species (0.96%), *Citrobacter freundii* (0.96%), *Klebsiella* species (0.96), and *Streptococcus pyogenes* (0.96%) (Table 4).

Table 4: Microorganisms isolated from 167 burn patients.

Isolated Microorganisms	**Number of isolate N=167**	**%**
Staphylococcus aureus	100	47.8
Pseudomonas aeruginosa	48	23.0
Candida albicans	11	5.3
Escherichia coli	11	5.3
Serratia plymuthica	8	3.8
Proteus mirabilis	6	2.9
Salamonella species	5	2.4
Staphylococcus epidermidis	5	2.4
Acinetobacter species	4	1.9
Streptococcus faecalis	3	1.4
Bacillus species	2	0.96
Citrobacter freundii	2	0.96
Klebsiella species	2	0.96
Streptococcus pyogenes	2	0.96
Total	209	100

DISCUSSION

The burn wound is considered one of the major health problems in the world (Rajput *et al.,* 2008). In the current study burn infection in males was 116 cases (58%), while in females it was 84 (42%). This result was in agreement with the finding reported by (Ghaffar *et al,* 2002) who found that burn wound infection in males was 189 (62.4%) while burn wound infection in females 114 (37.6%). In a similar study, Macedo and Santos (2005) found that burn wound infection in males 120 (59.1%) was more than burn wound infection in females 83 (40.9%). Also, Vostrugina *et al.,* (2006) found that burn infection in males was (76%) while burn infection in females was (24%).This may be due to that males are exposed more to burns and wear loose fitting clothes like dhoti, lungi and phiran which catch fire easily also mostly restaurant workers are males engaged in cooking. Other study reported by Bagdonas *et al.,* (2004) found that burn wound infection in males was 1447 (64.4%) while burn wound infection in females were 799 (35.6%). In contrast to Rajupt *et al.,* (2008) showed that burn infection in females (60%) was more than male (40%) in India.

In this study, it was found that the highest distribution of burn wound infection found within the age group <10 years 84 (42%). This result was in agreement with the findings reported by Al- Akayleh, (1999) that showed that the age group <10 years had the highest distribution of burn wound infection in burn patients. In the other hand, Ghaffar *et al.* (2002) and Shakibaie *et al.* (2008) found that the age group 10-19 years was more susceptible to burn wound infection than other age groups. Kwong and Chung (1985) found that the age group 19-40 years 23 (55%) were more susceptible to burn wound infection than other age groups.

Children were the most susceptible group to burn wound infection in Sana'a city 70 (35%), followed by students 49 (24.5%) and house wife 45 (22.5%). Few cases were recorded in waiters working in restaurants 5 (2.5%), engineers 2 (1%), soldiers and peasants (0.5% for each). The relationship between patient's job and had burns wound infections showed no statistical significant ($P > 0.05$).

Data in this investigation showed that 169 (84.5%) of burn infection patients had second-degree burn, 26 (13%) had third-degree burn, 3 (1.5%) had fourth-degree burn and 2 (1%) had first-degree burn. The statistical significant association

between degree of burn and burn wound infection was in third-degree (X^2 =3.5, *P*-value = 0.06) while there wasn't statistical association between other jobs and burn infection. Similarly, Al-Akayleh, (1999) showed that the highest distribution of burn wound infection found in burn patients who had second-degree burn (53.9%).

Flame burns were the most common type in burn infection patients in Yemen 139 (69.5%), followed by scald burns 49 (24.5%), electrical burns 9 (4.5%) and chemical burns 3 (1.5%). The lowest statistical significant association between cause of burn and burn wound infection was in burn patients who had electrical burns and burn patients who had chemical burns (X^2 =1.94, *P*-value = 0.1) and (X^2 =0.6, *P*-value = 0.4 respectively) while there is no statistical significant relation between burn infection and other causes. These findings are in agreement with Ghaffar *et al.,* (2002) in India who found flame burns were the most common types in burn infection patients. Kerosene was the main accelerant accounted for burns. This is probably because kerosene is cheap and easily accessible and more use of kerosene stove and kerosene lamp by the people of low socioeconomic status in rural area, where obsolete and unsafe uses of fire for cooking and light are still prevalent.

Staphylococcus aureus (47.8%) was the most commonly isolated bacteria among burn patients with burn wound infection in Sana'a city, followed by *P. aeruginosa* (23%), *E. coli*, *Serratia* species, *P. mirabilis*, *S. epidermidis*, *Bacillus* species, *Acinetobacter* species, *S. faecalis, Klebsiella* species *Citrobacter freundii*, *Salmonella* species and *S. pyogenes*. This result was similar to that reported by Naqvi *et al.* (2007), Bagdonas *et al.* (2004), Elsayed *et al.* (2003) and Rahbar *et al.* (2005) who found that the most prevalent bacteria among burn patients was *S. aureus*. In the other hand, AL-Akayleh, (1999) and Sharma *et al.,* (2006) found that the most prevalence isolated bacteria from burn wound patients were *P. aeruginosa, Klebsiella, S. aureus, P. mirabilis,* while the least prevalence isolated bacteria was *E. coli.* Our study showed that *C. albicans* was the only isolated fungi from burn wound infection cases in burn patients (5.19%). This finding was in agreement with Elsayed *et al.,* (2003).

S. aureus is a versatile human pathogen. It was the predominant cause of burn wound infection in pre antibiotic era and still persists as an important pathogen, strongly considered as a major cause of nosocomial infection. Interestingly the frequency of infection has increased during last three decades. Burn units have become major reservoir for *S. aureus* that has the special characteristics for spreading quickly in a hospital environment (Gang *et al.,* 2000). This pathogen has been reported as a major cause of nosocomail infection in Europe (Wildemauee *et al.,* 2004).

Edwards-Jones and Greenwood (2003) mentioned that burns become infected because of the environment at the site of the wound is ideal for the multiplication of infecting organisms. The immune-suppressive status of the patient and the immediate lack of antibodies allow the microorganisms to multiply freely. There is a plentiful supply of moisture and nutrients in the physical environment; the temperature, gaseous requirements, etc. are ideal for growth. Bacteria will proliferate rapidly; the mean cell generation time in optimum conditions is approximately 20min.Therefore, a single bacterium cell can increase in numbers within a 24 h period to over 10 billion cells.

In conclusion, the most common causative agents of burn wound infection in burned patients treated at Teiba Center for Burns Surgery in Al-Jumhory Hospital during 2008- 2009 were *Staphylococcus aureus, Pseudomonas aeruginosa* and *Candida albicans*

REFERENCES

Abubakar, E. M. (2009): The use of *Psidium guajava* Linn. in treating wound, skin and soft tissue infections. *Scientific Research and Essay*, 4(6): 605-606.

Agnihotri, N.; Gupta, V. and Joshi, R. M. (2004): Aerobic bacterial isolate from burn wound infections and their anti-

biograms- a five-year study. *Burns*, 30: 241-243.

Ahmad, S.I and Iranzo, O. G. (2003): Treatment of post burns bacterial infections by Fenton reagent, particularly the ubiquitous multipledrug resistant *Pseudomonas* species. *Medical Hypotheses*, 61(4): 431–434.

Al-Akayleh A.T. (1999): Invasive burn wound infection. *Annals of Burns and Fire Disasters*, XII – (4): 1-3.

Bagdonas, B.; Tamelis, A.; Rimdeika, R. and Kiudelis, M. (2004): Analysis of burn patients and the isolated pathogens. *Lithuanian Surgery*, 2(3):190-193.

Cheesbrough, M. (1984): Medical Laboratory Manual for Tropical Countries. ELBS with Butterworth-Heinemann, vol. II Microbiology, Cambridge, UK. 154-198.

Edwards-Jones, V. and Greenwood, J. E. (2003): What's new in burn microbiology. *Burns*, 29: 15–24.

Ekrami, A. and Kalantar, E. (2007): Bacterial infections in burn patients at a burn hospital in Iran. *Indian Journal Medical Research*, 126: 541-544.

Elsayed, S.; Gregson, D. B.; Lloyd, T.; Crichton, M. and Church, D. L. (2003): Utility of Gram stain for the microbiological analysis of burn wound surfaces. *Arch Pathology Laboratory Medical*, 127: 1485-1487.

Ghaffar, U. B.; Husain, M. and Rizvi, S. (2002): Thermal burn: An epidermiological prospective study. *Indian J. Academy* of *Forensic Medicine*, 30(1):10-14.

Gang, R. K.; Sanyol, S. C.; Bay, R. L.; Mokaddas, E. and Lari, A.R. (2000): Staphylococcal septicaemia in burn. *Burns*, 26(4):359-366.

Garrity, G. J.; Brenner, D. J.; Krieg, N. R. and Staley, J.T. (2005): Berages Manual of Systematic Bacteriology. 2nd edition 2 part A. Springer Science Business Media, Inc, New York, USA.

Kwong, Y.L. and Chung, C.H. (1985): The use of tegaderm transparent dressing in the qut patient management of partial thickness burns. *Journal of the Hong Kong Medical Association*, 37(4): 187-188.

Macedo, J. L. S. and Santos, B. (2005): Bacterial and fungal colonization of burn wounds. *Mem Inst Oswaldo Cruz, Rio de Janeiro*, 100(5): 535-539.

Mozingo, D. W.; Smith, A. A.; McManus, W. F; Pruitt, B. A. and Mason, A. D. (1988): Chemical burns: retrospective review. *Journal of Trauma*, 28: 642–847.

Naqvi, Z.; Hashmi, K. and Kharal, S. A. (2007): Methicillin resistant *Staphylococcus aureus* (MRSA) in burn patients. *Pakistan Journal of Pharmacology*, 24(2):7-11.

Nasser, S.; Mabrouk, A. and Maher, A. (2003): Colonization of burn wounds in Ain Shams University burn unit. *Burns* 29: 229-233.

Song, W; Lee, K.M; Kang, H. J; Shin, D. H and Kim, D. K. (2001): Microbiological aspects of predominant bacteria isolated from the burn patients in Korea. *Burns*, 27(2): 136–9.

Rajput, A.; Singh, K.P.; Kumar, V.; Sexena, R. and Singh, R.K. (2008): Antibacterial resistance pattern of aerobic bacteria isolates from burn patients in tertiary care hospital. *Biomedical Research*, 19 (1): 1-4.

Rhbar, M.; Gra-Agaji, R. and Hashemi, S. (2005): Nosocomial blood stream infections in Imam Khomeini Hospital, Urmia, Islamic Republic of Iran, 1999–200. *La Revue de Santé de la Méditerranée orientale*, 11(3): 479-481.

Shakibaie, M. R.; Shahchraghi, F.; Hashemi, A. and Adeli, S. (2008): Detection of TEM, SHV and PER type extended-spectrum B-Lactamase genes among clinical strains of isolated from burn patients at Shafa-Hospital, Kerman, Iran. *Iranian Journal of Basic Medical Sciences*, 11(2): 105-107.

Sharma, B. R.; Harish, D.; Singh, V. P. and Bangar, S. (2006): Septicemia as a cause of death in burns: An autopsy study. *Burns*, 32: 545–549.

Vostrugina, K; Gudavičiene, D and Vitkauskiene, A. (2006): Bacteremias in patients with severe burn trauma. *Medicina (Kaunas)*, 42(7): 576-578.

Wildemauee, C.; Godard, C.; Vershragen, G.; Claeys, G.; Duyck, C. and Beenhouwer, H. (2004): Ten years phage typing of Belgian clinical methicillin-resistant *S. aureus* isolates. *J. Hospital Infection*, 56: 16-18.

ARABIC SUMMARY

الميكروبات المصاحبة للإلتهابات جروح الحروق فى صنعاء- اليمن

سعيد منصر الغالبى، عبدالرحمن عبدالله حميد، الهام الشيبانى و إبتسام الحمزى
قسم علوم الحياة، كلية العلوم، جامعة صنعاء، صنعاء، اليمن

تعتبر الالتهابات الميكروبية لجروح الحروق من أكثر العوامل المؤدية الى تعقيدات فى مرضى المصابون بالحروق، حيث أن أكثر من ٧٠% من الوفيات فى مرضى الحروق ناتجة من الالتهابات الميكروبية.

أجريت هذه الدراسة خلال الفترة من يوليو ٢٠٠٨ وحتى فبراير ٢٠٠٩م بمركز طيبة للحروق في المستشفى الجمهوري التعليمي بمدينة صنعاء- اليمن.

تم جمع ٢٠٠ عينة قيح جروح الحروق من ٢٠٠ مريض مصابون بالحروق منهم ٥٨% ذكور و ٤٢% إناث. أكثر الفئات العمرية عرضة للالتهابات جروح الحروق هى الفئة العمرية ≤ ١٠ سنة بنسبة ٤٢% وكانت الحروق من الدرجة الثانية أكثر شيوعاً بين المرضى المصابون بالتهابات جروح الحروق (٨٤.٥%) يليهم مرضى حروق درجة ثالثة (١٣%) ،ثم حروق درجة رابعة (١.٥%) وباقى المصابون من الدرجة الأولى.

كما أظهرت الدراسة أن مرضى الحروق بسبب الحروق الحرارية كانوا أكثر المرضى نسبة لإصابات الحروق بالميكروبات (٦٩.٥%) يليها السمط (٢٤.٥%) ،ثم الحروق الكهربية (٤.٥%) و٣ حالات فقط نتيجة الحروق الكيميائية.

وقد لوحظ أن من أصل ١٦٧ عزله موجبه فى المزارع أن البكتيريا الموجبة لصبغة جرام أكثرها عزلاً من المصابين بالحروق (٤٤.٣%) تليها البكتيريا السالبة لصبغة جرام (٢٨.٧%) وهناك حالات تم عزل خليط من البكتيريا الموجبة والسالبة بنسبة ٢٠.٤%. وأكثر العزلات البكتيرية انتشارا بين مرضى الحروق كانت ستافيلوكوكس أوريس *Staphylococcus aureus* (47.8%) ثم سيدوموناس إيروجينوزا *Pseudomonas aeruginosa* (23%) ثم فطر الكانديدا البيكنس *Candida albicans* و بكتيريا القولون *Escherichia coli* (٥.٣% لكل منهما) . أما باقى العزلات البكتيرية فقد تم عزلها بنسب منخفضة.