

The Effect of Bacterial Infections on the Immune States in Eczematic Patients

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Abstract

Background: Eczema is one of most important global diseases that affects both genders at all age groups, the relationship between bacteria and allergy in Eczematic patients is still as a great need of studies to show more of the microbial role in eczema.

Objective: This study has been investigating the main common bacterial secondary infections associated with Eczema lesion and estimation the serum levels of immunoglobulin types and cytokines in both patients and control groups.

Material and Method: Swabs samples were taken from infected eczema lesions in patients consulting in Dermatology Consultation Unit in Medical Marjan City in Al-Hilla Province. Microbiology investigation for swabs were done with antibiotic sensitivity test. Blood was collected for measuring the concentrations of serum IgG, IgA, IgM by single radial immunodiffusion assay, IgE, IL-1 β , IL-4, and IL-10 were measured using ELISA kits.

Results: The noted profile of bacteria associated with cases of pyogenic eczema were *Staphylococcus aureus* (81.08%), *Streptococcus pyogenes* (5.1%) and *Pseudomonas aeruginosa* (8.1%). Several skin areas were affected, such as Hands (35.13%), Thighs (18.9%) and Feet (18.9%). The relation between pyogenic Eczema lesions and Occupation, Season and Geography were studied. At the immunological level, we found a significant increased ($p \leq 0.05$) in the concentrations of IgM, IgG, IgA and IgE compared with control groups with a significantly increased ($p \leq 0.05$) in the concentrations of cytokines (IL-1 β , IL-4, and IL-10) that stimulated the Th2 antibody production.

Conclusion: We concluded that the bacterial infections played an important role in systemic humoral and cellular immunity in eczematic patients.

Keywords: Bacterial infections; immunoglobulin; cytokine & Eczematic patients.

Introduction

Eczema (atopic dermatitis) is a type of skin inflammation and common skin diseases that can cause a variety of symptoms, from an itchy red rash to patchy sores. ... However, are not all people with eczema will experience infections^(31,25) The infections of the skin and soft tissues of most Common infections, may lead to local and dangerous Systemic complications. These infections can be Potentially life-threatening has been progressing

rapidly; Therefore, early recognition and appropriate medical²². Eczema is a specific inflammatory reaction of the skin which includes a range of highly etiologically heterogeneous clinical conditions⁹

Surgical management task *Staphylococcus aureus* and *Streptococcus pyogenes* plays an important role in skin and soft tissue infections and contributes of most complex skin disorders such as atopic dermatitis and other skin lesions²⁴. (*S. aureus*) colonization/

infection is a very common and important factor in the pathophysiology of a topic dermatitis⁷.

Bacterial resistance against commonly used antibiotics has increased considerably in the last decades. The most common causes of secondary bacterial infections of the skin are staphylococci and. Secondary infections to skin lesions can be potentially life threatening and may progress rapidly^(20,23).

Systemic immune response had been altered when foreign bacterial antigen enter the body through skin with suppression it's immunological barrier, Related pathological changes Includes intracellular edema of the skin and skin Inflammatory infiltration of predominantly lymphocytes

Macrophages²⁶ Eczema is associated with an increased in the serum immunoglobulins (IgG, IgM, IgA and IgE) levels with induction of Th2 cytokine rather than Th1 cytokine through counter balanced between them⁵. Furthermore, the induction of different immunological levels were considered to be antigen-specific mechanisms^(1,10). pro-inflammatory cytokines an increased the migration of inflammatory immune cells into the skin with elevated the IgE levels through down-regulated expression of the anti-microbial peptides necessary for host defense mechanisms^(8,13). The activation of Th2 increased the eosinophilia activity with different types of cytokines (IL-4, IL-5, IL-6, IL-9,

and IL-13) that created a microenvironment suitable for Th2 cell differentiation⁴.

The current work aims at isolation and identification of bacteria causing secondary infection of Eczema, with measurement of serum levels of immunoglobulin types and cytokines at both patients and control groups.

Material and Method

1. Bacteriological Study: Swabs samples were taken from the superlative exudates of infected Eczema lesions in patients consulting in Dermatology Consultation Unit in Medical Marjan City in Al-Hilla Province. was taken by means of sterile disposable swab and inoculated into peptone water as transport medium for aerobic bacteria between the clinic and the bacteriological laboratory

Microbiology investigation for swabs were done according to Cowan and Steel (1985). Gram stain were done and biochemical test according to Collee et al., 1996; Forbes et al., 2010; Leboffe and Pierce, 2011), antibiotic sensitivity test were done as in Brown (2007).

2. Immunological Study: Blood was collected for measuring the concentrations of serum IgG, IgA, IgM by single radial immunodiffusion assay, IgE, IL-1 β , IL-4, and IL-10 were measured using ELISA kits. (provided from Ray Bio, USA, Company).

Results and Discussion

Table (1): culture and physiological characters of bacteria isolates from the pyogenic eczema lesion

Characters	S. aureus	S. pyogenes	P. aeruginosa
Gram stain	+	+	-
Shape	Cocci in groups	Cocci in chain	Rods
Growth condition			
Aerobic	+	+	+
Motility	-	-	+
Hemolysis on blood agar	β	β	β
Pigment	Golden yellow endopigment	-	bluish green exopigment
Catalase	+	-	+
Oxidase	-	-	+
Nitrate reductase	-	ND	+
Amylase	ND	ND	-
H ₂ S	ND	ND	-
Lactase	+	ND	-
Mannitol	+	-	ND
Sucrose	+	ND	ND

Patients Profile: The patients were distributed according to the bacterial isolates infections that caused Eczema into 4 groups with one group considered to be control (G5) as in table (2). Bacterial infection was found in some patients, The bacterial infection rates in each type of eczema and dermatitis are summarized in table (2). Staphylococcus aureus is the bacterium that is most commonly responsible for secondary infection of eczema. 55.56%.S. aureus is the predominant bacteria on the uninvolved palms of patients with atopic dermatitis²⁸. in study done by²³ S. aureus was present in eight (35%) of lesions infections and was isolated from all areas. and S. aureus was mixed with group A haemolytic streptococci in one case. Group A haemolytic streptococci were isolated mainly from the extremities. Gram-negative aerobes (P. aeruginosa and E. coli) were isolated from areas on the leg and trunk.

In Singapore mentioned that S.aureus was the commonest organism causing secondary infection of skin lesions and represented 67%, 43.5% and 45% of all positive cultures respectively³⁰.

Staphylococcus aureus is the bacterium that is most commonly responsible for secondary infection

of eczema It is often associated with hair follicle infections (folliculitis), boils and abscesses.¹⁹ Marwa et al. (2007) record that the bacteria S.aureus was the most commonly isolated organism (92.9%), followed by Enterobacteriaceae (35.7%) and Pseudomonas (14.3%) in eczema lesions, S. aureus isolates were obtained from 14 (34%) patients with eczema lesions²³

The S. aureus colonization rate was higher in atopic dermatitis patients, which might be due to the skin barrier defects and imbalance of immune function¹⁶. The result of present study agree with Marwa et al. (2007) showed that Gram-negative bacilli were the second common pathogens causing secondary infection of skin lesions and were found in (21.7%) of all cases. And agree with²⁰ who found that enteric Gram-negative bacilli together with Strept. pyogenes were the second most common causes of secondary infection where each of them represented (23%) the distribution of infections showed in the table (3) the thigh and the hand was the most infected part from the body²⁰ recorded that the most infected part of the body were the finger, scalp, face and neck.

Table (2) Profile of patients according to the bacterial isolates

Groups	Bacterial Isolates	Numbers	(%)
G 1	S. aureus	50	55.56
G 2	S. pyogenes	20	22.22
G 3	P. aeruginosa	12	13.33
G4	S. aureus+ S. pyogenes	8	8.88
G5	Control	20	-

Table (3) Distribution of secondary bacterial infection according to the anatomical site of

Location	No	%
Thighs	13	35.13
Hands	13	35.13
Feet	7	18.7
Ears	3	8.1
Scalp	1	2.7
Total	37	

Testing for the antibiotic sensitivity of staphylococci, Streptococci and Pseudomonas are done

the three isolates were resistance for most of antibiotic use as showed in the figures (1, 2 and 3)

S. aureus isolates had good sensitivity to clindamycin, chloramphenicol, and Methicillin while they were resistant to penicillin, ampicillin, tetracycline and cefotaxime.

Streptococcus pyogenes isolates had good sensitivity to clindamycin, chloramphenicol, and Methicillin while they were resistant to penicillin, ampicillin, tetracycline and cefotaxime. While Pseudomonas aeruginosa isolates were for chloramphenicol and Methicillin

High resistance of S. aureus to ampicillin and penicillin may be indicate with the high incidence of β -lactamase production by staphylococci in the current study, Fusidic acid resistance may be due to the extensive use of topical fusidic acid by patients suffering from secondary skin infections. in the UK the S.aureus isolated from dermatology were high resistance to fusidic acid 50%²⁷.

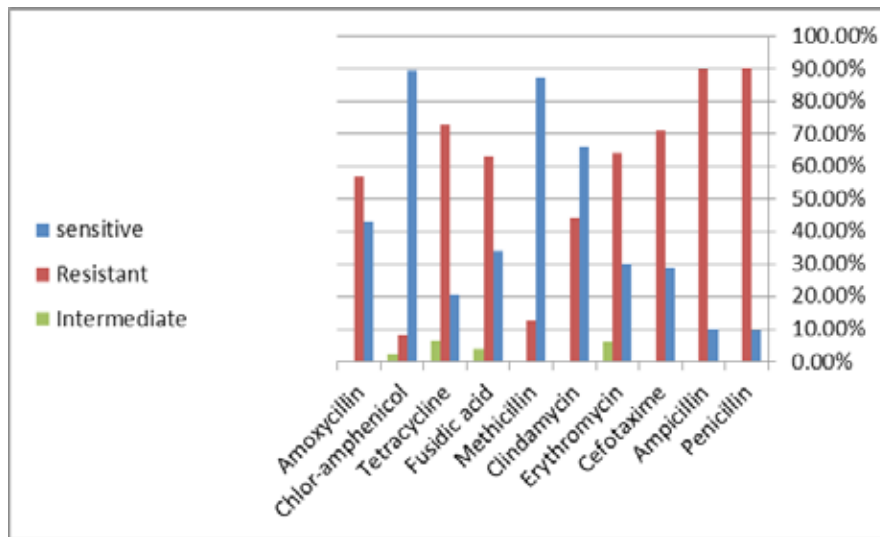


Fig (1) antibiotic sensitivity test of S.aureus

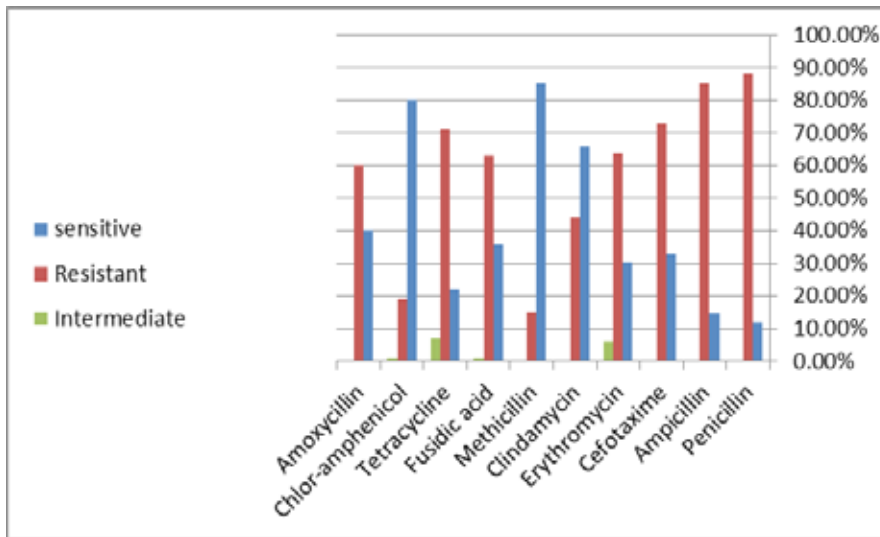


Fig (2) antibiotic sensitivity test of Streptococcus pyogenes

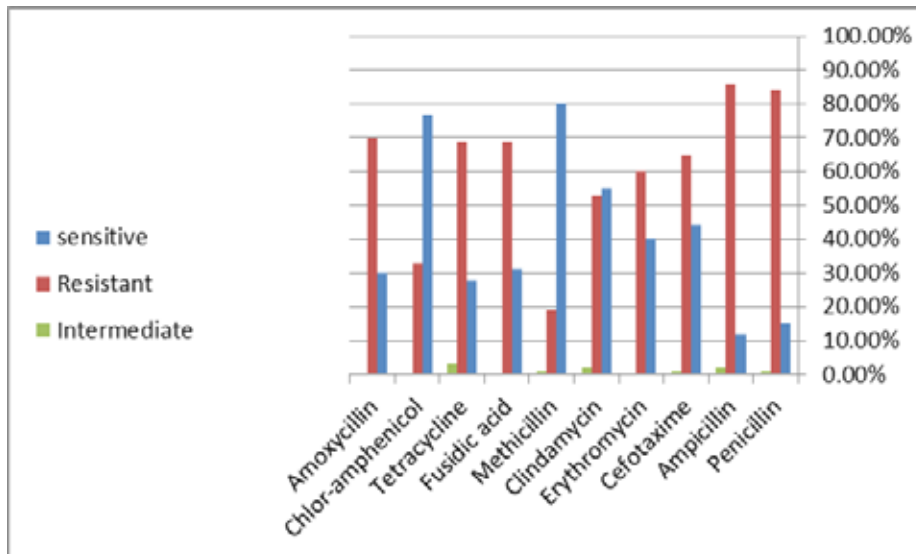


Fig (3) antibiotic sensitivity test of Pseudomonas

At immunological level we found a significant increased ($p \leq 0.05$) in the concentrations of IgM, IgG, IgA and IgE (mg/dl) compared with control groups as in table (3), thus the immunity of Eczematic disease involved mainly humoral immune response associated with a cell-mediated immunity towered many types of exogenous and endogenous factors, or an non specific reaction^(1,14). Increased in IgE concentrations facilitated

the release of different types of inflammatory mediators from mast cells, basophils and immune

Cells involved with Eczema pathogenesis with chemotactic for eosinophils to the site of infections¹². Others studies suggested that the elevated levels of serum antibodies in Eczematic patients may be associated with other pathogens through secondary infections (Roberts).

Table (3): Concentrations of immunoglobulins types in Eczematic patients

Groups	Mean Concentrations (mg/dl)							
	IgG M±S.D.	P- value	IgM M±S.D.	P- value	IgA M±S.D.	P- value	IgE M±S.D.	P- value
(G 1)	1231.42±57.5	0.041 ^a	245.86±36.8	0.021 ^a	223.82±16.7	0.001 ^a	483.18±57.9	0.030 ^a
(G 2)	1197.31±43.8	0.021 ^b	223.74±30.8	0.001 ^a	219.15±14.8	0.000 ^a	367.23±53.9	0.020 ^b
(G 3)	1132.67±23.8	0.100 ^c	137.59±30.4	0.100 ^b	159.70±15.9	0.100 ^b	357.87±36.8	0.120 ^b
(G 4)	1245.38±67.2	0.040 ^a	299.08±40.5	0.101 ^b	220.99±13.8	0.010 ^a	586.63±65.9	0.100 ^c
(G5)*	1115.56±57.4	0.000 ^d	132.53±93.6	0.000 ^c	127.58±91.7	0.000 ^c	190.85±73.2	0.000 ^c

*Control groups

Table (4) showed a significant increased ($p \leq 0.05$) in the concentrations of cytokines that used in this study and this agree with many previous studies had been explained that skin microbial infections inducted the cytokines when penetrated the skin of patients and suppression the skin barrier then bind with IgE on Langerhans' cells, that stimulated TH2CD4 to produce IL-4, which stimulated the IgE production by B lymphocytes^(3,15). IL- 10 had a regulatory role in an inflammatory response and we found the IL-10 polymorphism associated with the elevated the level of IgE in Eczematic and allergic diseases with inhibited

the production of pro- inflammatory cytokines⁶. IL-1 β is a pro- inflammatory cytokines played an important role in the pathogenesis of Eczema that produced from the inflammation of skin and activate Th1CD4 cells proliferation and differentiation². So the bacterial infections affected the systemic immune responses at both humoral and cellular levels that had been seen when the allergic reactions elevated the IgE antibody with increased in numbers of eosinophil because the receptors of this antibody found on the surface of eosinophil and mast cell¹¹.

Table (4): Concentrations of cytokines in Eczematic patients

Patients group	Mean Concentrations (pg/ml)					
	IL-1 β M±S.D.	P- value	IL-4 M±S.D.	P- value	IL-10 M±S.D.	P- value
(G 1)	305.34±34.6	0.004 ^a	91.33±2.31	0.020 ^a	210.63±1.30	0.030 ^a
(G 2)	296.26±32.9	0.200 ^b	76.13±1.22	0.001 ^b	109.57±1.29	0.001 ^b
(G 3)	274.89±24.9	0.010 ^c	70.02±4.01	0.100 ^b	98.39±1.98	0.000 ^c
(G 4)*	79.64±52.2	0.000 ^d	34.82±1.94	0.000 ^c	86.63±6.76	0.000 ^c

*Control groups

Conclusion

From all of the above, we concluded that the bacterial infections played an important role in systemic humoral and cellular immunity in Eczematic patients and both of them produced chronic inflammatory response through stimulated antibody production and secreted of cytokines. Eczema lesion are commonly seen in hand and feet. And lesions were associated with *S. aureus*, *P. aeruginosa* and *S. pyogenes*. From all of the above, we concluded that the bacterial infections played an important role in systemic humoral and cellular immunity in Eczematic patients and both of them produced chronic inflammatory response through stimulated antibody production and secreted of cytokines.

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Conflict of Interest: None to declare.

Ethical Clearance: All experimental protocols were approved under the College of Science for Women, Department of Biology, University of Babylon, Iraq and all experiments were carried out in accordance with approved guidelines.

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