

***Dermanyssus gallinae* (Acari: *Dermanyssidae*) a cause of recurrent papular urticaria diagnosed by light and electron microscopy**

**Original
Article**

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ABSTRACT

Background: Papular urticaria is a prevalent disturbing condition manifested by chronic or recurring papules caused by a hypersensitivity response to the bites of mosquitoes, bedbugs, fleas, and other insects. *D. gallinae* was previously indicated as an etiological agent for papular urticaria and chronic itching by several researchers worldwide.

Objective: To throw light on *D. gallinae* as a cause of papular urticaria in Upper Egypt discussing associating risk factors.

Material and Methods: The present study evaluated patients attending the Dermatology Outpatient Clinic, Sohag University Hospitals, Egypt, and who were diagnosed as papular urticaria. Some patients with recurrent papular lesions gave history of exposure to domestic poultry or birds' nests and insect bites. They were selected from 97 patients who complained of itching. They were advised to bring any insects suspected of biting them or that come in contact with their skin, which were then referred to the Parasitology Unit for identification by light (LM) and scanning electron microscopy (SEM).

Results: The examined arthropods were identified as *D. gallinae* in thirty cases and human fleas in two cases. LM and SEM showed the remarkable identifying features of *D. gallinae* female. Contact with sources of infection (insects) either birds' nests or chicken husbandry was proved to be a risk factor for recurrent papular urticaria. Contact of the same family members to the same source of infection caused prevalence of arthropods borne recurrent papular urticaria among family members. Gender and residence were not associated risk factors.

Conclusion: This is, to the best of our knowledge, the first report of *D. gallinae* infestation in Egypt. Pruritic dermatitis caused by *D. gallinae* (associated with papules and vesicles) may sometimes be mistaken for scabies. Therefore, meticulous history recording, and environmental inspection are necessary to discover the etiology of recurrent papular urticaria.

Key Words: *Dermanyssus gallinae*, dermatitis, pruritus, SEM, Upper Egypt

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INTRODUCTION

Papular urticaria is a prevalent cutaneous lesion and often disturbing manifestation of chronic or recurring papules caused by a hypersensitivity response to insect bites. Individual papules may present as a circle or wheal with a central punctum^[1]. Children, adult males, non local inhabitants, and those belonging to urban or peri-urban areas may be more vulnerable to papular urticaria^[2].

Patients usually record chronic or repeated episodes of a papular burst that tends to take place in groups or clusters associated with intensive pruritus. The burst is distinguished by crops of symmetrically disseminated pruritic papules and papulovesicles^[3]. The lesions can also be manifested in a region exposed to insect bites and may exist on any body part. The lesions tend to be grouped on bared areas, mostly the extensor surfaces of the extremities.

Sometimes, a centric hemorrhagic punctum may be obvious with ecchymoses and brownish pigmentation persisting after resolution^[4].

Fleas, mosquitoes and bedbugs are the insects most commonly associated with these rashes, however any other insects could cause the same skin reaction^[5]. Fleas and other insects thrive well during summer months and that is why cases of papular urticaria are predominant during these months^[1,6]. Flea bites produce maculopapular or papular rashes and severe pruritus^[7,8]. About 50 species of mites can cause lesions in human skin. Cutaneous reaction to mites is usually papular or vesicular, with intense pruritus^[9]. The chicken mite, *Dermanyssus gallinae*, is vastly distributed, and was described for the first time in 1778 by de Geer^[10]. Adults measure around one millimeter in length^[11], are colored black, grey or white without host blood in their system; but after feeding mature mites turn red^[12]. Beside

adults which ordinarily are found near breeder farms, these mites have four stages in their life cycle: egg, larva, protonymph and deutonymph. *D. gallinae* mites pose a danger to birds bred for meat and egg production^[13]. At first it was believed to be a pest of chickens, however, it affects more than 30 species of birds including pigeons, rock doves, sparrows, and starlings. In their absence other available mammals including humans act as hosts^[14].

D. gallinae mites cause extreme itching, allergies and dermatitis^[12,13]. The first human infestation was suspected by Willan in 1809, and in 1828 de Saint-Vincent was the first to observe the parasite on the skin of an infected individual^[15,16]. In addition to the ectoparasitic activities, it was declared that *D. gallinae* mites act as vectors for some bacteria such as Salmonella, Rickettsia, *Spirocheta* and *Pasteurella*^[17].

The objective of our study is to confirm the medical importance of arthropods especially *D. gallinae* as a prevalent causative agent of recurrent papular urticaria in upper Egypt.

MATERIAL AND METHODS

To achieve our objective, a descriptive analytical study was conducted in the Dermatology Outpatient Clinic, Sohag University Hospitals, in the period from June to September 2017.

Selection of patients: Examination of 97 patients who complained of itching revealed erythematous excoriated and some urticated papules in different parts of their body mainly on the extremities. Complete relief of the condition was achieved in 38 patients after medication by steroids and antihistamines. After meticulous recording of history, 32 patients who gave history of insect bites or exposure to domestic poultry or birds' nests, were advised to collect any insects that bite them or come in contact with their skin. These were then referred to the Parasitology Unit, Sohag University, for identification both by light (LM) and scanning electron microscopy (SEM).

Light microscope analysis (LM)^[18]: Samples were processed for examination under light microscope. Briefly, samples were passed in 10% KOH solution at room temperature for overnight or more according to specimen clearance. Then, samples were passed consecutively in different ethanol gradients (70%, 80%, 90%, 95% and finally 100%) for dehydration. Following final dehydration, they were doused in xylene before mounting on slides in distyrene (a polystyrene), a plasticiser (tricresyl phosphate), and xylene (DPX). Examination and photographing of the samples were completed in the Parasitology Department, Faculty of Medicine, Sohag University, Egypt.

Scanning electron microscope (SEM) analysis^[19]: Arthropods were fixed in 5% glutaraldehyde for 24 hours followed by: (1) washing in soda-cacodylate acid (pH 7.3) (four times, 10 min/wash); (2) fixation in

osmium tetroxide 1% for 2 hours; (3) washing in soda-cacodylate acid (three times, 10 min/wash); and (4) dehydration in a graduated acetone series (30, 50, 60, 70, 80, 90, 95, and 100%, 5 min each). Samples were then incubated at 20-25°C, stuck on double scotch tape carbon and coated with gold. Examination and photographs of the samples were performed in SEM Unit, Central Laboratory, Sohag University, Egypt.

Ethical approval and informed consent: Informed consent was obtained from all adult participants and parents of the children included in the study

Statistical analysis: Data analysis were performed using the statistical package for social sciences (SPSS) version 16. Chi-square test was used to assess the significance of association of recurrent papular urticaria with the independent variables. Fischer exact test was used when number of cells is less than 5. *P* value less than 0.05 was considered statistically significant.

RESULTS

All 97 patients subjected to the present study, complained of itching and were diagnosed on clinical examination as papular urticaria. The age of participants ranged from 2 to 40 years; 66 (68%) were children up to 10 years, and 31 (32%) were adults; 65 (67%) were females; 81 (83.5%) were from urban areas.

On treatment with known antihistaminic and topical steroids 38 (39.2%) patients showed complete recovery with no recurrence of their complaint, while 59 (60.8%) patients suffered recurrence of the condition upon drug suspension (Table 1).

Of the 59 cases with recurrent papular urticaria, 4 (6.8%) gave history of chicken husbandry, 26 (44.1%) recalled the presence of bird nests in the windows of their houses, 2 (3.4%) mentioned exposure to insect bites. The remaining 27 (45.7%) did not mention having contact with any type of insects (Table 2). Ten patients (16.9%) were from rural areas, while 49 (83.1%) were from urban areas with no statistical significance (*P* >0.05). From four families, 27 out of 59 patients (45.8%) had the same complaint, while 32 (54.2%) patients did not give history of family involvement (*P* < 0.05). All patients with history of positive family involvement conceded to contact with a source of arthropods, either birds nest (23/27) or chicken husbandry (4/27). On the other hand, among patients with negative history of family involvement, the majority (29/32) of patients gave no history of presence of birds' nests or chicken husbandry and only 3 patients recalled the presence of birds' nests in their houses (Table 2). Therefore, family involvement is not a risk factor for recurrent papular urticaria but exposure of the family members to the same source of infection causes affection of more than one member and predominance of this symptom among families.

Clinical examination of the 59 patients showed that skin lesions were in the form of papules and crusted lesions. It was observed that 45.8% (27/59) of patients had papular lesions only while 54.2% (32/59) had both papules and crusted lesions which was statistically non-significant ($P > 0.05$). Skin lesions were apparent on different parts of the body. The most common sites were the exposed areas as legs (25.4%) and arms (27.1%) in 41 (76.3%) patients; 18 (23.7%) patients had lesions over covered parts of their body with no statistical significance ($P > 0.05$) (Table 3 and Plate I).

Arthropods were identified as *D. gallinae* in 30 (50.8%) cases and human fleas in 2 (3.4%) cases (Table 1). Using LM, *D. gallinae* adult female (1 mm long) was identified by its characteristic morphological structures as dorsal shield, long styliform chelicerae in the anterior part and mesostigmatal pore between coxa 3 and coxa 4 (Plate II). SEM examination (Plate III), showed dorsal shield with projecting shoulder that is largely rounded posteriorly, the genitoventral shield broadly rounded posteriorly and the anal shield. Identification of the mite was confirmed by the characteristic lack of setaj 3 on the dorsal shield, reticulation on dorsal shield and ventral shield, and the anal shield with three anal setae around anal opening.

Table 1: Patients data and causes of recurrent papular urticaria

Residence/Gender		Papular urticaria		Arthropods involvement		
		Recurrence		Positive		Negative
		No No. (%)	Yes No. (%)	<i>D. gallinae</i> No. (%)	Flea No. (%)	No. (%)
Rural	Female	5 (5.1)	8 (8.2)	4 (6.7)	1 (1.7)	3 (5.1)
	Male	1 (1.1)	2 (2.1)	1 (1.7)	0 (0)	1 (1.7)
Urban	Female	21 (21.6)	31 (31.9)	16 (27.1)	1 (1.7)	14 (23.7)
	Male	11 (11.3)	18 (18.6)	9 (15.3)	0 (0)	9 (15.3)
Total		38 (39.2)	59 (60.8)	30 (50.8)	2 (3.4)	27 (45.8)

Table 2: Risk factors of recurrent papular urticaria

Source of infection/Gender		Residence		Family involvement	
		Rural	Urban	Negative	Positive
		No. (%)	No. (%)	No. (%)	No. (%)
Bird nest	Female	4 (6.8)	13 (22)	2 (3.4)	15 (25.4)
	Male	1 (1.7)	8 (13.6)	1 (1.7)	8 (13.6)
Chicken husbandry	Female	0 (0)	3 (5.1)	0 (0)	3 (5.1)
	Male	0 (0)	1 (1.7)	0 (0)	1 (1.7)
None	Female	4 (6.8)	15 (25.4)	19 (32.1)	0 (0)
	Male	1 (1.7)	9 (15.2)	10 (17)	0 (0)
Total		10 (17)	49 (83)	32 (54.2)	27 (45.8)
Statistical analysis		P > 0.05		P < 0.05	

Table 3: Type and site of skin lesions

Lesion	No.	%	Statistical analysis
Type			
Papules and crusts	32	54.2	P > 0.05
Papules only	27	45.8	
Site			
Neck	4	6.8	P > 0.05
Chest	6	10.2	
Trunk	8	13.6	
Forearm	16	27.1	
Hand	8	13.6	
Leg	15	25.4	
Foot	2	3.4	
Total	59	100	



Plate I: Cutaneous manifestations in patients due to infestation by *D. gallinae*. Papular urticaria affecting different parts in the body.

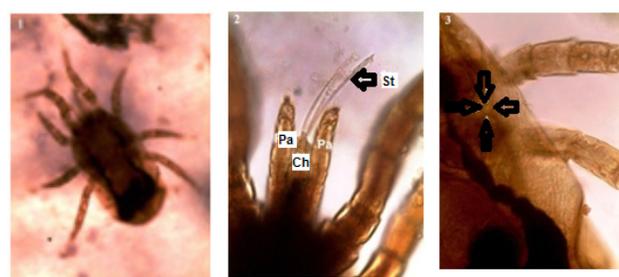


Plate II. Identification of *D. gallinae* by LM.

Fig. 1: Adult female (1 mm long) with characteristic dorsal shield,

Fig. 2: Anterior part with pedipalps (Pa), chelicerae (Ch), with long stylet (St),

Fig. 3: Mesostigmatal pore between coxa 3 and coxa 4 (arrows).

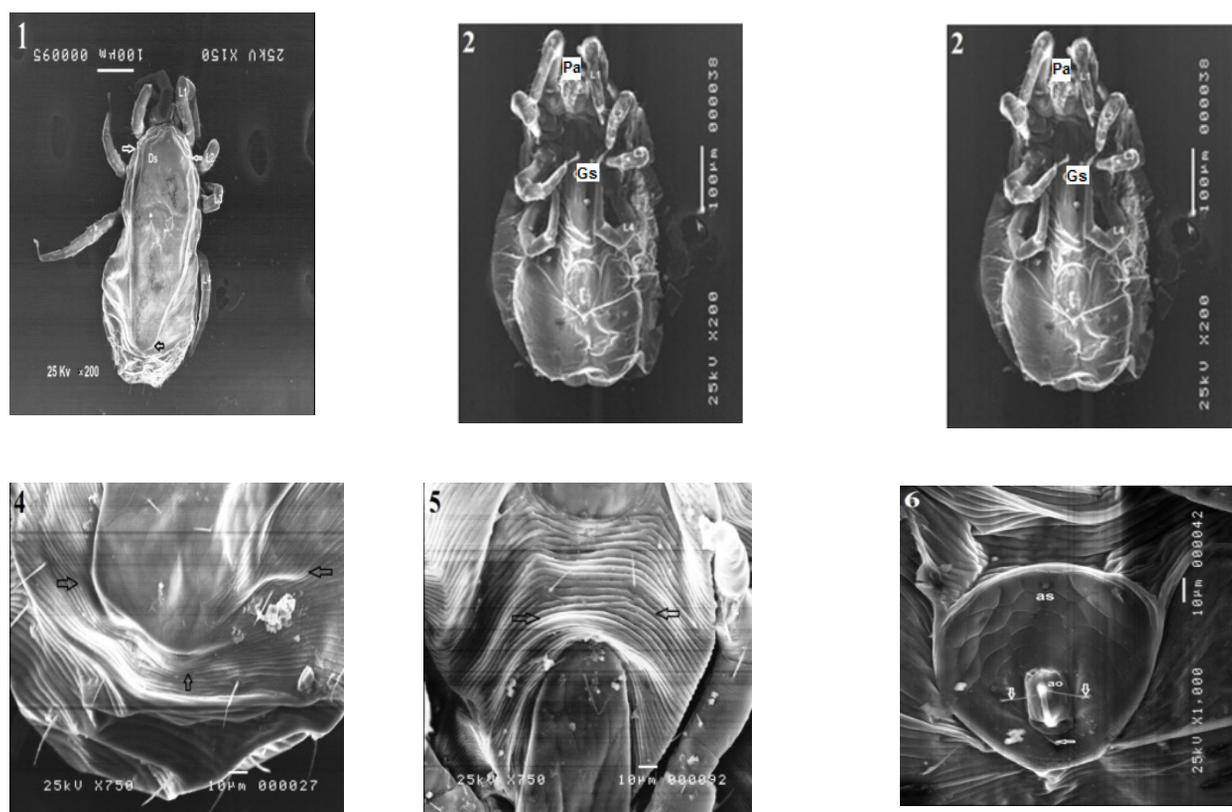


Plate III: Identification of *D. gallinae* by SEM.

Fig. 1: Dorsal overview showing the idiosoma, Dorsal shield (Ds) with projecting shoulder and largely rounded posteriorly (arrows) and 4 pairs of legs (L1- L4).

Fig. 2: Ventral overview showing pedipalps (Pa), Genito-ventral shield (Gs) broadly rounded posteriorly (arrows) and 4 pairs of legs (L1- L4)

Fig. 3: Lack of seta j3 on the dorsal shield (arrows).

Fig. 4: Reticulation on dorsal shield (arrows).

Fig. 5: Reticulation on ventral shield (arrows).

Fig. 6: Detail of the anal shield (as) with three anal setae (arrows) around anal opening (ao).

DISCUSSION

Papular urticaria is a widespread skin disorder mainly affecting children, manifested by chronic or repetitive papules due to a hypersensitivity stimulus to the bites of mosquitoes, bed bugs, fleas and other insects^[20]. In the present study, the majority of patients were children and this was consistent with previous studies^[2,5,21,22]. Cases were recorded in summer months, in agreement with the habits of fleas and other insects that flourish during summer. The majority of patients (76.3%) had lesions of papular urticaria over exposed parts of the body which is in accordance with other studies^[23,24].

Recurrent papular urticaria in the form of skin rash that lasted for few days and disappeared after medications to reappear in most of our patients was caused by insects. In only a small group of patients, arthropod agents were not involved. Apparently contact with arthropods raised the risk of recurrence of papular urticaria. It is not surprising that many of the patients in this study had history of similar eruptions in their family; all of them gave history of contact with either birds' nests or chicken husbandry, while most of the patients with negative history of family involvement had no history of contact with any source of insects. So occurrence of recurrent papular urticaria in more than one member of the same family is explained by sharing the same environment, exposure to the same source of infection and being bitten by the same arthropods^[2]. It means that family involvement is not a risk factor for occurrence of recurrent papular urticaria but exposure of family members to the same insect causes prevalence of this disease among families.

Fleas were the causative arthropod in only 2 patients, although fleas have been reported as the most common arthropod cause of papular urticaria^[5]. However this was an expected result since fleas are difficult to trap.

D. gallinae proved to be the cause of recurrent papular urticaria in the major group of patients. Diagnosis was confirmed both by LM and SEM. *D. gallinae* was previously detected as an etiology for papular urticaria and chronic itching by several researchers worldwide^[15,23,25], but to the best of our knowledge it is the first time to be recorded in Egypt. *D. gallinae* associated diseases are often linked to synanthropic birds, mostly pigeons and their nests and roosts; multiple cases of nosocomial, army residence, university offices and school infestations have been reported for this mite^[26,27].

D. gallinae is a part of the Mesostigmata superfamily. In the absence of its usual host it may attack other mammals including humans causing dermatitis, recognized as papulosquamous rashes and urticarial lesions^[28]. *D. gallinae* mites produce pruritus or allergic reactions induced by salivary proteins deposited during feeding^[29]. The potential medical significance of *D. gallinae* is intensified by the

fact that these mites can hold and convey both viral and bacterial zoonotic diseases^[30].

Patients in the present study had erythematous papular rashes on different parts of their body including the trunk, arms, front of the neck and thighs. In some cases, erythematous macula-papular rashes were covered with a crust due to violent itching specially on forearms and neck. Rashes were solitary on the trunk in some cases, while in most cases rashes were in the form of few papules on exposed and covered parts of the body. These findings are in accordance with other studies that showed that *D. gallinae* infestations may affect different parts of the body causing intensified itching and pruritic dermatitis usually on the backs of the hands, face, forearms and scalp; and rarely may infest the nares, orbits and eyelids, and genitourinary and rectal orifices^[15,31,32].

LM and SEM micrographs identified mites gathered by the patients as *D. gallinae* females which is in accordance with the habits of these mites where mature females must suck blood from their hosts while males occasionally feed on blood^[33]. Identification of these mites was based on the following characteristic features: idiosoma broadly rounded posteriorly, dorsal shield with eminent shoulder, stylet-like process on the cheliceral article, reticulations of the dorsal and ventral shield, lack of setae j3 on the dorsal shield, mesostigmatal pores between coxa 3 and 4, and three anal setae around anal opening^[29,34]. Identification of the cryptic species *D. gallinae* requires both morphological and molecular studies^[34].

CONCLUSION

These cases are of clinical significance because most dermatologists have difficulty identifying ectoparasites that cause new or atypical conditions. This may lead to misdiagnosis with other pruritus and be treated with antihistamines and topical corticosteroids with temporary relief of the symptoms. In such cases, clinical signs and symptoms are usually caused by bites from avian mites that have infested domestic poultry or birds nesting in or near human habitation. Pruritic dermatitis caused by *D. gallinae* (associated with papules and vesicles) may sometimes be mistaken for scabies, so meticulous history recording, and environmental inspection are necessary to discover and deal with the etiology of papular urticaria.

Author contribution: NS Ahmed and WM Abdel Elmaged conceived the idea. NS Ahmed and AM El-Kady contributed to the interpretation of the results. NS Ahmed, AM El-Kady and AM Almatary participated in the analysis of results and preparation of the manuscript. All authors read and approved the final version of the manuscript. results.

CONFLICTS OF INTEREST

We declare that we have no conflicts of interest.

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