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Role of Patch Test in Allergic Contact Dermatitis.

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Abstract: *AllergiccontactDermatitis(ACD) is an altered state of reactivity induced by an exposure to external agent. Substances which induce contact dermatitis after single or multiple exposures may be irritant or allergic in nature. Patch testing is the diagnostic tool for ACD. This study was conductedon 100 patients with Hand and Foot Dermatitisto identify the allergen.Age group selected was between 11-70yrsexcluding pregnants and infants and results noted after 48hours.Out of 100 patients 60% cases were positive(58.82% males, 62.5% females) with mean age group for males 41.44yrs and females 37.81yrs . Isolated foot Dermatitis accounted for 33.33% of total positive cases (35% males, 30%females). Isolated hand Dermatitis accounts for 20% of total cases(31.25% females, 14.7%males).Hand and foot Dermatitis accounts for 26.66% of total positive cases(26.47%males, 25%females). Patch testing was helpful to establish allergic etiology in more than half of the cases investigated by us and itremains an indispensable tool to demonstrate the presence of contact allergy. Metals were the most common cause of hand dermatitis and rubber for foot. Commonest allergenwaschromium for males and nickel for females.*

Keywords:*Contact dermatitis, Patch testing, hand and foot dermatitis.*

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I. Introduction

Allergic Contact Dermatitisis one of the most frequent and vexing problemwith significant socioeconomic impact, and is a leading cause of industrial illness. ACD, "Dermatitis venenata" represents an immunological manifestation of type IV cell- mediated delayed hypersensitivity reaction of the skin to contact allergens. Diagnosis is based on careful history combined with knowledge of common allergens and irritants in the environment. Allergic reactions to Nickel dichromate, ethylenediamine hydrochloride, rubber compounds, paraphenylenediamine and parabens play a significant role in the production and maintenance of hand dermatitis. Hot, humid environment within shoes combined with number of chemicals, leather, rubber, glues or more rarely by dyes, creates an ideal situation for ACD of foot. In 1896Jadassohn described patch test, whichremains the „GOLD STANDARD" till now.Properly applied and correctly interpreted patch tests are, at present, the only scientific proof of allergic contact dermatitis.The suspected substance is applied to the skin under occlusion for 2 days and observed. We aimed to evaluate all suspected ACD cases of Hand and Feet by patch test using the Indian Standard Series to identify the causative Allergen (s).

II. Materials And Methods

A cross sectional study conducted on 100 clinically suspected cases of ACD of either hands, feet or both attendingSkin OPD, Osmania General Hospital, Hyderabad, from august 2012 to august 2013 after ethical clearance and after takingconsent from patients. *Inclusion criteria*: all patients with ACD of the Hands or Feet or either with isolated dermatitis.

***Exclusion criteria*:** Irritant Dermatitis, photodermatosis, Infective dermatitis and Endogenous eczemas, Palmoplantar Psoriasis, Stasis eczema, Lichen simplex chronicus. Patients who have received oral steroid in past 2 weeks. Pregnant and infants.

***Test material*:** All cases were patch tested with all the 29 antigens of the Indian Standard Series obtained fromSystopic Laboratory, New Delhi.

***Procedure*:** Three patches holding 10 antigens each were placed over back of the patient fixing the chambers for even dispersion of the allergen and finally taping against the skin.

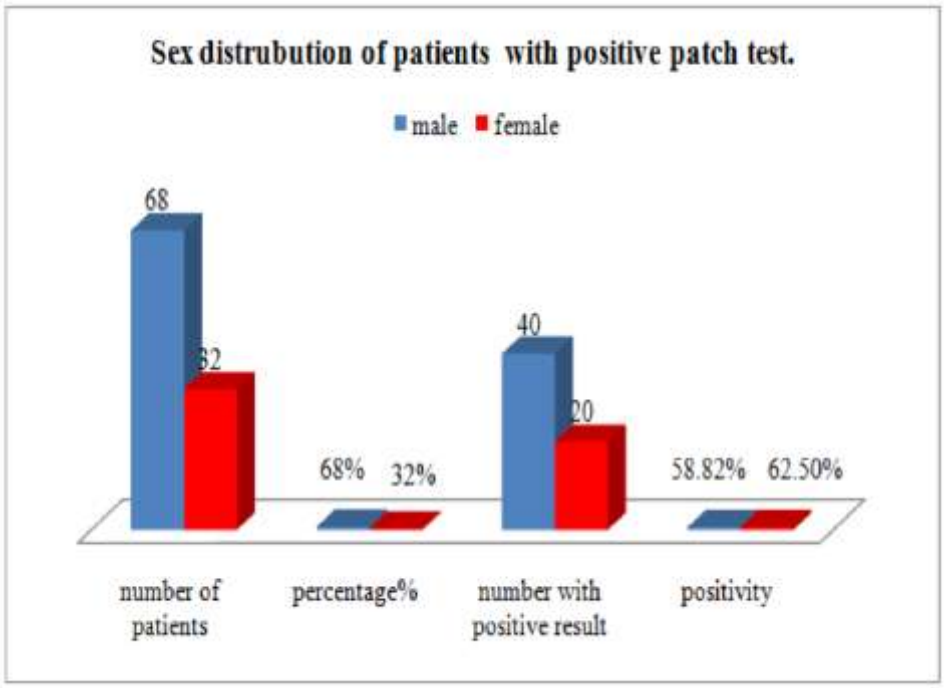
***Interpretation of test result*:** patches were removed on Day 2 and readings were taken after 1 hour to allow erythema to settle.Second reading was taken on Day 4. A template made from one of the patches was used to determine the patch position of a reaction and results were recorded on a standardized printed form. The Patch test reactions were graded according to the recommendations of the International Contact Dermatitis Research Group (ICDRG).

+? Doubtful reaction, faint erythema only
+ Weak positive reaction, erythema, infiltration, possibly papules.
++ Strong positive reaction; erythema, infiltration, papules, vesicles.
+++ Extreme positive reaction, intense erythema and infiltration and coalescing vesicles

***Statistical analysis*:**
Data was analyzed statistically and presented in forms of charts and percentages.

III. Results

Out of 100 patients(68 male,32 females) of all ages(10-70years) were enrolled in the study after applying inclusion and exclusion criteria. Data collected was presented in form of charts and percentages.Mean age group for males was 41.44yrs and females 37.81yrs. ACD incidence was 5.5%. out of 100 patients 60 were positive of antigens of Standard series reflecting a positivity rate of 60% to the Indian Standard Series. 40 out of 68 males(58.82%) and 20 out of 32 females(62.5%) were tested positive. The positivity rate was higher in the female.

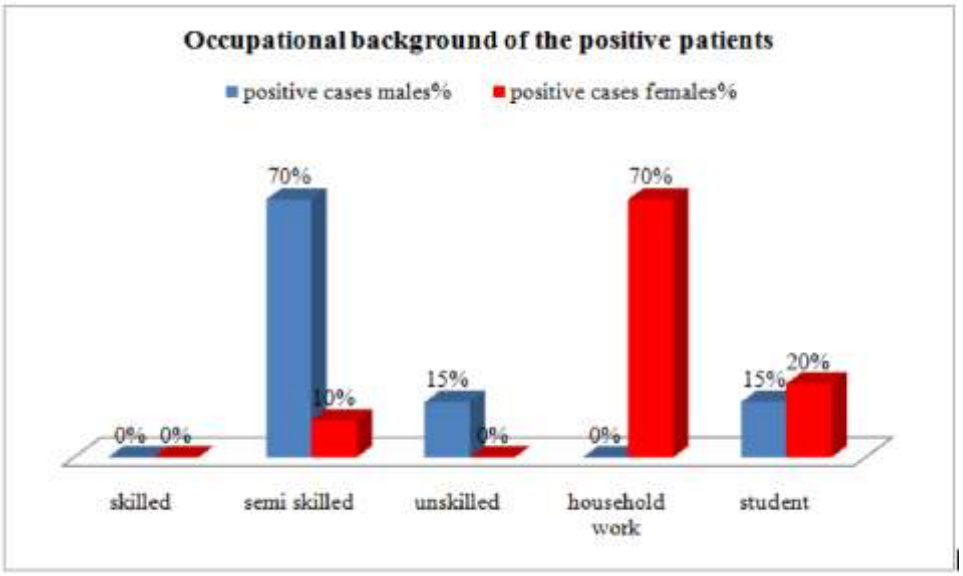


The age group showing the maximum number of cases (34%) was 31-40 years age group accounting for 29.4% of the total male patients and 43.75% of the total female patients. Positively tested mean age of males was 38.5years and females was 31.4years with average mean 36.13 years. 33.3% of the total positively tested cases and 50% of the positively tested female patients and 25% of the positively tested males were of the 31-40 yrs. However in the male patients, highest positivity rate was seen in the 21-50 years age group (65%) as majority of the suspected cases of this age group were positive. In females 80% of the +ve cases were between the ages of 21 -40 years.

Table.1 Age and sex distribution of Patients with positive patch test.

Age groups	Males 68		Females 32		Total		Positive cases				total	
	number	%	number	%	number	%	males	%	females	%	number	%
11-20	4	5.88	2	6.25	6	6	2	5	2	10	4	6.66
21-30	10	14.7	6	18.75	16	16	8	20	6	30	14	23.33
31-40	20	29.4	14	43.75	34	10	10	25	10	50	20	33.33
41-50	14	20.58	2	6.25	16	16	8	20	-		8	13.33
51-60	10	14.7	6	18.75	16	16	4	10	-		4	6.66
61-70	10	14.7	2	6.25	12	12	8	20	2	10	10	16.66

82% of male patients were semiskilled workers (Teacher, Businessman, Clerk, Pharmacist, Driver, Painter, Mechanic, Welder, Policeman, Mason, Carpenter, Cobbler, Cook etc.) and 75% females were house wives. 70% of the positive male were semiskilled workers and 70% of the positive females were housewives. Of the total positive cases, the semi-skilled group, accounted for 50% of the cases, housewives for 23.3% and students for 16.67% the unskilled group accounted for the least number of cases (10%).



Isolated Foot Dermatitis

Isolated Foot Dermatitis was nearly twice(36%) as common as Isolated Hand Dermatitis (20%). Affected 35% of +ve males,30%+ve females accounting 33.33% of the total +ve cases. **IsolatedHand Dermatitis:**

Isolated Hand Dermatitis was commoner in females(31.25%) than in males(14.70%)accounting30%of total female+ve cases.

Hand and Food Dermatitis:

Hand and Food Dermatitis showed equal predominance both in males(26.47%) and females(25%)accounting 26.66% of the total +ve cases. Male+ve(30%)cases were of Hand and Food Dermatitis than 20% of female+vecases.

Table.2 Sites affected in both sexes and positive cases.

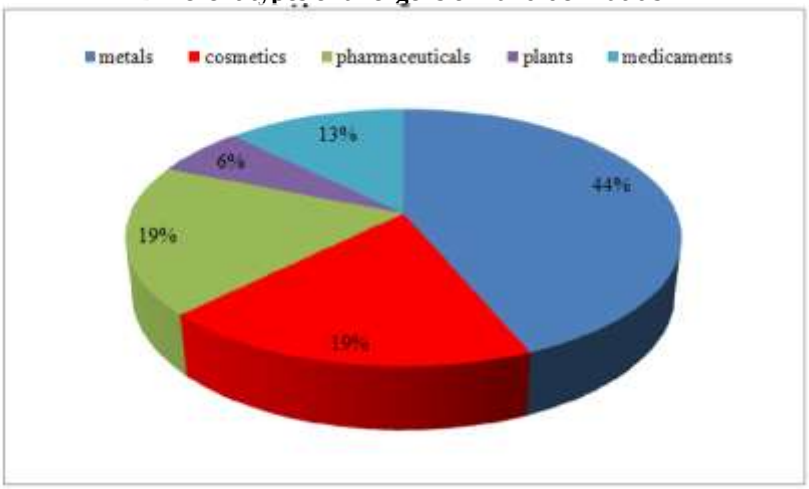
Site	Males 68		Female 32		Total 100		Positive cases					
							Males 40		Females 20		Total 60	
	no	%	no	%	no	%	no	%	No	%	no	%
Hands	10	14.7	10	31.25	20	20	6	15	6	30	12	20
Feet	26	38.24	10	31.25	36	36	14	35	6	30	20	33.33
Hands &feet	18	26.47	8	25	26	26	12	30	4	20	16	26.66
Hands &/or feet& other sites	14	20.58	4	12.5	18	18	8	20	4	20	12	20

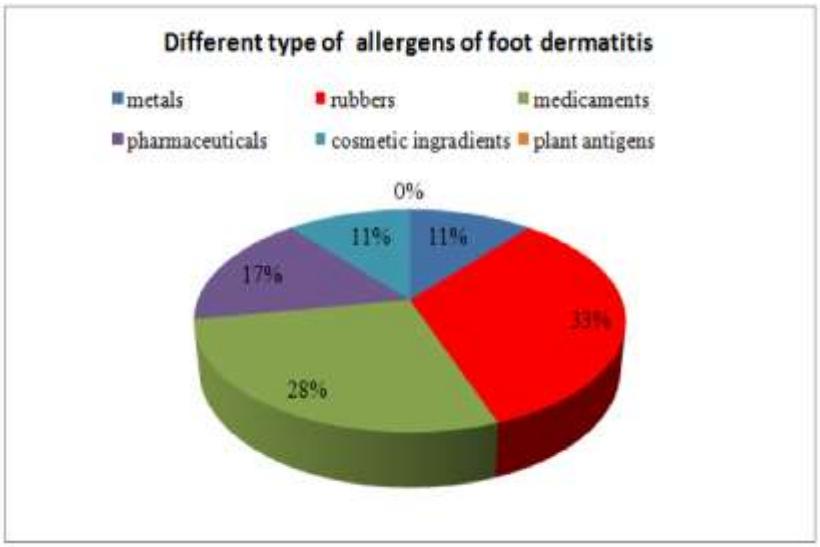
History of atopy, present in 18 patients(20.9%) of whom 8 were tested positive(44.44%). Out of 68 Males(58.82%) and 20 of 32 females(62.5%) were Positive. Thus a total of 60 patients were +ve reflecting a positivity of 60% to Indian Standard series of antigens. In isolated Hand Dermatitis the most common allergens were Metals(43.75%) followed by Pharmaceutical and cosmetic(18.75%), Medicaments(12.5%)and Plant Antigens(6.25%). In isolated Foot Dermatitis, it was observed that Rubber(33.33%) and Medicaments(27.77%) sensitivity was common. Pharmaceuticals accounted for 16.66%. Metals and Cosmetics accounted for 11.11% each.In Hand cum Foot Dermatitis, Metals were the commonest(41.66%). Cosmetic sensitivity was seen in 25%. Plant antigen and Rubber sensitivity was seen in 12.5% each.

Table.3 Region Wise Reactionswith different allergens

Allergen group	Hand dermatitis		Foot dermatitis		Hand & Foot dermatitis	
	No	%	No	%	No	%
Metals	14	43.75	4	11.11	20	41.66
Rubbers	-		12	33.33	6	12.5
Medicaments	4	12.5	10	27.77	-	
Pharmaceuticals	6	18.75	6	16.66	4	8.33
Cosmetic ingredients	3	18.75	4	11.11	12	25
Plant antigens	2	6.25	-		6	12.5

Different types of allergens of hand dermatitis





The metals ranked first(32.75%) followed by cosmetics ingredient(18.96%). Rubbers(15.51%), Pharmaceutical group of antigens(13.79%) and finally the Plant antigens(6.89%). The Rubbers cum Cosmetic ingredients(34.4%) and Antibiotics cum Pharmaceuticals(25.8%). In Males highest positivity was seen to the Metal group of antigens(30.76%) followed by Cosmetics ingredients(20.51%). Least positivity was to Plant antigens(7.69%). In Females the highest positivity was to Metals(36.84%) followed by equal positivity to Cosmetics, Rubbers and Pharmaceuticals(15.78%) each and the least to Plant antigens(5.26%).

Table.4 Incidence of different Allergens

Allergen group	Total no of reactions seen		Males		Females	
	No	%	No	%	No	%
Metals	38	32.75	24	30.76	14	36.84
Cosmetics	22	18.96	16	20.51	6	`15.78
Rubbers	18	15.51	12	15.38	6	15.78
Pharmaceuticals	16	13.19	10	12.82	6	15.78
Antibiotics	14	12.06	10	12.82	4	10.52
Plant antigens	8	6.89	6	7.69	2	5.26
Miscellaneous	-				-	
Cosmetics+ Rubber	40	34.77	28	35.89	12	31.56
Antibiotics+ Pharmaceuticals	30	25.85	10	25.64	10	26.30

Nickel showed the highest incidence(12.06%)commonest in females followed by Potassium Bichromate and Cobalt(10.34% each)commonest in males. Among the Rubbers, Mercaptomix and MercaptoBenthiazole where common(10.34% each). Black Rubber mix showed a positivity of 1.72% while no positivity was seen to Thiuram mix. Of the Antibiotics, Nitrofurazone was commonest(10.34%) followed by Gentamycin(3.44%), Neomycine(1.72%), no positivity was seen to Benzocaine and Chinoform. Among the
Cosmetic ingredients, fragrance mix was commonest(10.34%), followed by Balsam of peril (5.17%), PPB(5.17%) and quaternium -15(1.72%). No positivity was seen to formaldehyde and Kathon CG. Among the Pharmaceuticals, Colophony(5.17%) was commonest followed by wool alcohol(3.47%) and PEG(3.44%) and the least with paraben(1.72%). Among the Plant Antigens, Parthenimnhysterophus showed a positivity of(10.34%). At least 13 Antigens of the Indian Standard Series gave no reaction.

Table.5 Incidence of single and multiple allergens

No of antigens positive to	Males 40	Females 20	Total 60	%
1	14	6	20	33.3
2	16	14	30	50
3	8	-	8	13.3
>3	2	0	2	3.33

The majority(50%) were positive to two allergens. 33.3% were positive to single allergen and 20% to three allergens. 3.33% were +ve to more than three allergens.

Table.6 Age wise distribution of allergens

Age group	Metals	Rubbers	Medicaments	Pharmaceutical	Cosmetic	Plant	Total
11-20	-	-	2(14.28%)	2(12.5%)	2(9.09%)	-	6(5.17%)
21-30	14(36.84%)	~	4(28.56%)	4(25%)	8(36.36%)	-	30(25.86%)
31-40	14(36.84%)	14(77.77%)	4(28.56%)	4(25%)	2(9.09%)	2(25%)	40(34.48%)
41-50	4(10.52%)	4(22.22%)	4(28.56%)	4(25%)	2(9.09%)	2(25%)	20(17.24%)
51-60	4(10.52%)	-	-	2(12.5%)	6(27.27%)	-	12(10.34%)
61-70	2(5.26%)	-	-	-	2(9.09%)	4(50%)	8(6.89%)

Metal sensitivity was highest in 21-30 years and 31-40 years(36.84%) age group.
Rubber sensitivity was highest in 31-40 years age group(77.77%). Medicament sensitivity was equal in age groups varying from 11-40(28.52%). Pharmaceuticals sensitivity was equal in age groups 21-30 years, 31-40 yrs, 41-50 yrs (25%) each. Cosmetic sensitivity was highest in the age group 21-30 years (36.36%). Plant sensitivity was highest in the age group 61-70(50%).Thus maximum sensitivity was seen in 31-40 years age group(34.48%) followed by 21-30 years(25.86%).

IV. Discussion

ACD of the hands and feet is a very common problem as these are the exposed areas of the body coming in contact with innumerable types of contactants in everyday life. Although the majority of cases are irritant in nature, the yield of relevant positive reactions to patch tests is remarkably high. The dermatitis responds dramatically once the offending allergen is identified and avoided and patch testing is thus of great value in the management of these dermatoses. In this study 100 cases of Hands and or Feet suspected to be of allergic etiology were taken up. After detailed history, examination and confirmation by biopsy they were patch tested with the Indian Standard series of antigens. The purpose of our study was to identify the allergens responsible for contact dermatitis of hands and feet. Incidence of ACD in our study was 5.6% when compared to

4.7% reported by Mendenhall et al[1]and 3.85% by Huda and Paul[2]. In our study Hand and Foot dermatitis cases accounted for 1.85% of the total outpatient cases and 32.7% of all ACD cases. Paul and Huda‟s study of 80 clinically diagnosed cases of Hand and Foot ACD reported 0.77% incidence accountingto 20% of all ACD cases.

Hand involvement was seen in 16.9% of the ACD cases with 6% having an isolated hand dermatitis. Sharma and Kaur[3] reported, 20% incidence of Hand dermatitis among ACD patients (Chandigarh) while Huda and Paul reported an incidence of 13.8%(Assam). Storrs et al[4] reported an incidence of 33% from North America. Calnan[5] and Goosens the incidence of hand dermatitis varied from 10.9% to 58%.Isolated foot dermatitis accounted for 9.8% of the ACD cases in our study which is corroboratory with the incidence reported by Huda and Paul(6.2%) and Angelim et al[6](3 to 6.3%) from footwear dermatitis. Males were found to be predominantly affected by Hand and Foot (male to female ratio 2.12:1). A higher incidence in males(1.66:1) was also reported by Sharma and Kaur in a study of 64 patients of Hand dermatitis while Huda and Paul study showed female preponderance(1.75:1). Gurmohan Singh and K.K.Singh[7] in a study of 70 patients of hand dermatitis reported a female to male ratio of 2.68:1, Similar female predominance was also reported by Bajaj[8]. Dermatitis mainly affected patients between 10 to 70 years of age. A similar age distribution was reported by Handa et al[9](13-70 years). Mean age of our patients was 36.1 years which is similar to studies reported by Handa et al(35 years), Sharma and Kaur(35yrs).

Our study age groups are slightly lower than those from the study by Gurmohan Singh and K.K.Singh where 80% of the cases were from age groups 11-40 years. In Huda and Paul study, maximum cases were from the 21-30 years age group and 16-24 years in the study by Meding[10]. Positive allergic reactions were most frequent in females in the age group of 31-40 years(50%) and in the males 31-40 years (25%) followed by 21-30 years, 41-50, 61-70 years with 20% each. Occurrence of more allergic reactions in female(31-40 years) is probably due to more exposure to wet work and detergents.A majority(58%) of our patients were semi skilled workers and 24% were housewives. Students accounted for 12% and unskilled manual laboures for 6%. A similar occupational distribution was seen by Sharma and Kaur(62.5% were semi skilled workers, 34% were housewives, students and unskilled labourers were 1.5% each). In the study by Gurmohan Singh and K.K.Singh, housewives formed the largest group (57%), semi skilledworkers(28.5%), students(10%) and labourers(4.2%). In our study+ve allergic reactions were most frequent in the semi skilled group among men(70%) and in the housewives among women(70%). A total of 50% of the total +vecases(males and females) were semi skilled workers and 23.33% were housewives. Students accounted for 16.67% of the +ve reactions and unskilled labourers for 10%. Highest incidence(semi skilled workers) of allergic reactions in our study were exposed at work to more number of sensitizers than others. However in the study by Gurmohan Singh and K.K.Singh, housewives accounted for 53% of their +ve cases, semi skilled workers for 36.5%, students for 7% and labourers for 2%. In Huda and Paul‟s study, housewives accounted highest number of positive cases(23.7%) followed by tea garden workers(17.5%). In both these studies, antigens prepared from vegetables, soaps and detergents were also tested.

Involvement of Hands,observedin 70% of the positively tested females and 65% of the positively tested males. A lower positivity in females with hand dermatitis was observed in the studies by Gurmohan Singh and K.K.Singh(58.8% in females and 57.8% in males). Hand dermatitis was common among housewives, could be because of repetitive damage of skin barrier by water and detergents predisposing to easier sensitization.

Involvement of feet observedin a total of 85% of the positively tested males and 70% of the positively tested females. Similar male predominance in foot dermatitis was observedbyHanda et al (60% of the positive cases were males and 40% females). This could be because of more number of footwear dermatitis among men. A personal or familial atopic predisposition was present in 18% of the patients . Among these 44.4% had a Positive Patch test Reaction. Thus a greater percentage of atopics (55.6%) where having a non allergic (irritant type of) Hand Foot Eczema probably as a result of cumulative exposure of the sensitive skin to primary irritants occupationally or domestically. Studies by Lamimintausta et al[11] suggest an increased risk of irritant hand eczema in atopics and they are less easily sensitized than other groupsIn 6of the positively reacted cases(10.7%) a family history of ACD was present suggesting some individual genetic susceptibility for sensitization. Two positively reacted female cases were mother and daughter both reacting to the same allergen, nickel. A 60% "heritability" of Nickel sensitivity was observed by Menne and Holm[12]. A study by Forsbecket al[13] suggests that siblings and children of patients suffering from ACD have an increased incidence of positive patch tests. In our study, more number of +ve patch test reactions were seen in the females(62.5%) compared to males(58.82%). Gurmohan Singh and K.K.Singh study, alsorevealed a higher rate of positivity in females (58.8%) as compared to 57.8% in males. In our study, higher rate of positivity in females accounted to nickel sensitive women sensitized by ear piercing, and cosmetic users. In males, large number of semi skilled workers presented to us with hand and/or foot dermatitis with occupational sensitivity.

In footwear dermatitis, study by Handaetalobserved 96.6% positivity to the shoe dermatitis. Screening antigens comprising of 16 allergens and scrapings from footwear were used. In a study of shoe dermatitis by Angelii et al, positive patch tests were seen in 65.4% of the patients suspected to have shoe allergy. In our study, 64 of 100 patients(64%) presented with Hand dermatitis occurring either as an isolated dermatitis or along with a foot dermatitis. Metals were the commonest sensitizers in Hand dermatitis. Metal sensitivity was seen in 20 patients(31.25%) of Hand dermatitis, Pharmaceuticals in 12 (18.75%), Cosmetics in 12(18.75%) patients, Plant Antigen in 8(12.5%), Medicaments in 6 (9.4%) and Rubberin 4(6.25%) patients.

The incidence in our study is lower than the study by Sharma and Kaur(incidence of 53.1% for metals, 40.6% for medicaments, 20.3% for rubbers). The reason for their higher values could be due to the greater percentage of semi skilled workers in their study. Thirtysix of 100 patients(36%) in our study presented with isolated foot dermatitis with Rubbers,being the commonest sensitizers. Rubber sensitivity was observed in 6(16.6%) and in 4 patients(10.4%) who presented with Hand dermatitis having a past history of allergy to rubber footwear. In the footwear dermatitis, studies by Tiwari et al[14] positivity to rubber chemicals ranged from 7-74%. Similar wide range of percentages were reported from California[15] and Nigeria[16](16-70%). Handa et al reported a rubber sensitivity as high as 87% in 30 foot wear dermatitis cases probably due to more usage of rubber slippers in their area. Colophony was positive in 2 patient(5.5%). A 17% sensitivity to colophony was reported by Handa et al. In shoe dermatitis, study by Lyndeet al[17], relevant positive reactions were seen in only 26.8%. In a study by Angelini et al, 65% of the patients were tested positive and reactions were to medicaments rather than to shoe allergens. In our study the foot dermatitis group of patients reacted more commonly to rubber, medicaments, and pharmaceuticals rather than Nickel.In the study by Handa, scrapings from suspected footwear observed 16% of footwear sensitivity. Thus patch testing of footwear pieces can give additional useful information in diagnosing footwear dermatitis.

Among the various groups of Hand and Foot Dermatitis in our study, Metal was the commonest sensitizer(24%) followed by Cosmetics(20%), Pharmaceuticals(12%), Medicaments(10%), rubbers(10%) and Plants(8%). A study by the Huda and Paul, soaps and detergents(30%) and vegetables and spices(26.2%) were the commonest sensitizers, with Rubber accounting for 20%, pesticides 10%, Industrial oil 7.5%, metals for only 3.75% and medicaments 2.5%. The reason could be the large number of housewives and tea plantation workers involved in pesticide spraying in their study. Thus a regional variation is evident here. In males Metal sensitizationwas the commonest(30.76%) followed by cosmetics(20.5%). Metal sensitivity was largely occupational and highlights that work related precautions and suitable regulations are necessary to prevent such work related sensitization.

In females metals predominated(36.84%) followed by cosmetics(15.78%), dueto of nickel sensitive patients sensitized by ear piercing, use of artificial jewelry and more cosmetic users among the women.

The commonest sensitizers in our study were Nickel(12.06%), chromium(10.34%) and Cobalt(10.34%). Chromium was the commonest sensitizer among males with 12 of the 68 males (17.64%) reacting to it. No chrome reactions were seen in the females. Sharma and Kaur have reported 22.2% Chrome sensitivity in males and 20.8% in females. Nickel was the commonest sensitizer in females. Eight of the 32 females(25%) showed positive tests while only one male patient reacted to it(8.82%). Sharma and Kaur found Nickel sensitivity 45.8% in females and 37.5% in males. Cobalt sensitivity was seen only in 6 male patient (8.82%).Three female patients had reacted to it.Among medicaments Nitrofurazone was the most frequent sensitizer, seen in 8 of the 100 patients (8%) followed by Gentamycin(6%) and Neomycin(2%). In Sharma and Kaur's study,nitrofurazone was the commonest(28.1%) followed by Neomycin(17.2%) and Sulfadiazine(12.5%). Twelve positively tested cases(21%) were positive to more than 3 allergens. No irritant reactions were seen to the standardized antigens of the Indian series. Thus patch testing was helpful in finding the incriminating cause of the dermatitis.

V. Conclusion

Patch test could identify primary causatives of the dermatitis in 83.33% and aggravating factors in 56.66% of the positively tested cases. Side effects were seen in only 4 cases. Once the allergen is identified by patch test, avoidance of the allergen is the one and only single factor in preventing relapse, which makes patch testing of great value in the management of ACD. "The greatest hazard is the omission of the patch testing procedures in the management of patients who have certain dermatomes. Such omission dooms these patients to repeated attacks of avoidable contact dermatitis", and all the more, it is a simple and easy test provided, the technique is followed properly. But at the same time being a bioassay, like any other such test has inherent errors(false positive, false negative reactions). But until a convenient and practical invitro test for contact allergy is developed patch testing remains an indispensable tool for the clinician and researcher.

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*Dr. Shankar Kunti. " Role of Patch Test in Allergic Contact Dermatitis." IOSR Journal of Dental and Medical Sciences (IOSR-JDMS) 16.8 (2017): 11-18