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Original Research Article

Association of metabolic syndrome and insulin resistance in papulosquamous diseases

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ABSTRACT

Background: Metabolic syndrome (MetS), insulin resistance (IR) and papulosquamous diseases with shared pathophysiology leads to conglomeration of risk factors of non-communicable diseases like cardiovascular disease (CVD) and type 2 diabetes (T2D) causing high mortality worldwide. The objective is to study the association of MetS and IR in papulosquamous diseases.
Methods: It is a hospital-based case-control study conducted on 200 age-sex matched cases and controls with consent. Subjects were administered a pre-validated questionnaire, diagnosis of papulosquamous diseases was based on clinical examination and skin biopsy. MetS was diagnosed based on national cholesterol education program's-adult treatment plan iii with Asian modification for abdominal circumference criteria. Fasting serum insulin levels (FI) was used as a surrogate marker of IR.
Results: Mean serum HDL- C level was low and statistically significant (p=0.017). Mean fasting plasma glucose level was significantly higher in patients (p=0.008). Mean FI level was significant between cases and controls (p=0.013). IR was found in 76% of cases which was significantly higher than in controls (p<0.05). IR was highest in psoriasis 29% followed by LP 22%, PRP 19%, and LS 6% which was statistically significant (p<0.05). MetS was mostly found in psoriasis (17%), LP (9%) and least in PRP, LS.
Conclusions: This study intends clinicians to do periodic MetS and IR evaluation in papulosquamous diseases. Thus, subclinical cases of non-communicable diseases can be detected and potential co-morbidities can be prevented.

Keywords: MetS, Skin diseases, Papulosquamous, Psoriasis, Lichen planus

INTRODUCTION

Papulosquamous diseases are a heterogeneous group of disorders characterized by scaly papules and plaques. These include psoriasis, lichen planus (LP), pityriasis rubra pilaris (PRP), parapsoriasis, lichen nitidus, lichen striatus (LS).[1] Many of the chronic dermatological conditions like psoriasis, LP share at least one of the pathogenetic mechanisms such as persistent proinflammatory state, oxidative stress and endocrine abnormalities.[2]

MetS represents clustering of metabolic risk factors like central obesity, hyperglycemia, hypertension and dyslipidemia. Although the exact etiology is uncertain, IR is considered a common mechanism for underlying derangements associated with the syndrome.[3] The most common worldwide used criterion is the one proposed by national cholesterol education program's ATP III with

Asian modification for abdominal circumference. It requires presence of at least 3 of following: Abdominal obesity: Waist circumference: ≥90 cm in men and ≥80 cm in women; elevated triglycerides: ≥150 mg/dl; reduced high-density lipoprotein (HDL) cholesterol: <40 mg/dl for men, <50 mg/dl for women; elevated blood pressure: ≥130 mmHg systolic or ≥85 mmHg diastolic; and elevated fasting blood glucose: ≥100 mg/dl.[4]

IR is defined as a defective metabolic response of insulin to stimulate glucose uptake into skeletal muscle and adipose tissue and/or to suppress hepatic gluconeogenesis and glucose release into circulation.[5] Serum insulin has an important role in homeostasis and physiology of the skin. Previous studies have observed IR association with acanthosis nigricans, acne and psoriasis.[6] Over the past few decades, there has been an alarming increase in the prevalence of MetS globally. Approximately, one-third of the adult population in developed countries and 18.3% of Indians have MetS.[4,5] There is paucity of clinical trials related to papulosquamous diseases other than psoriasis with MetS. Hence analysing association of MetS and IR in papulosquamous diseases play a vicious role in early identification of risk of CVD and T2D. This cross-sectional study was done to analyze the association of MetS and IR in papulosquamous diseases.

METHODS

A hospital-based case-control study conducted in the Oxford medical college, hospital and research centre. Hundred consecutive patients with papulosquamous diseases in 20 to 50 years age group attending dermatology outpatient department were recruited during the period of June 2020-May 2021. Hundred age and sex matched healthy control subjects with no personal history of dermatological disorder recruited, were hospital employees or patients' attenders. Written informed consent was obtained for all the recruited subjects. Those who are on treatment for skin diseases, diabetes, hypertension, dyslipidemias, pregnant and lactating women were excluded from the study. Subjects were administered a pre-validated, semi structured questionnaire to collect socio demographic and clinical profile. Diagnosis of papulosquamous diseases was mainly based on through clinical history and examination. Skin biopsy from the lesion was done only in case of doubt. The study was approved by the institutional research and ethical committee.

The diagnosis of MetS was based on national cholesterol education program's- adult treatment plan III with Asian modification for abdominal circumference criteria.[4] There are several methods for diagnosis of IR, we used Fasting serum insulin levels, as a surrogate measurement of IR.

Measurement of various parameters

Height (m) was measured using a measuring tape stuck to the wall. Weight (Kg) was measured on electronic weight scale and waist circumference (cm) was measured at the level of iliac crest using a measuring tape. Measurements were recorded by a single observer with subject in standing posture.

Body mass index (BMI) was calculated as weight in kg divided by square of height in meters. Obesity classification according to Asia-Pacific guidelines include 18.5-22.9 normal, 23-24.9 overweight, ≥25 obesity.[7]

Patient in sitting posture using sphygmomanometer, blood pressure (mm/Hg) was measured.

Venous blood was drawn from subjects after fasting for 12 hours. Fasting plasma lucose was measured by using Glucose oxidase-peroxidase (GOD-POD) method and total triglycrides (TG) by enzymatic method. Serum high density lipo-protein-C (HDL-C) by phosphotungstate precipitation, followed by enzymatic method. All the parameters were analysed using a fully auto-analyser.

FI was measured using hormone analyzer (clinical laboratory improvement amendments: CLIA).

Statistical analysis

The data was recorded in Microsoft excel and analysed using SPSS software (version 22). Continuous data was expressed as mean and standard deviation and categorical data as proportion. The significant difference between the groups was assessed by Student 't'-test and one way analysis of variance for continuous data and Chi-squared test for categorical data. Pearson correlation was used to test the correlation between categorical data. $P<0.05$ was considered to be statistically significant for all the tests.

RESULTS

A total of 200 subjects, age-sex matched cases and controls were included in the study. Male-to-female ratio of the enrolled subjects was 1.2:1. The mean age was 44.1±4.0 and 43.2±3.2 of cases and controls respectively. There was no significant statistical difference in age, sex, height and weight between cases and controls. The mean ± SD of BMI and waist circumference in cases was comparable to controls (p=0.11; p=0.08 respectively) (Table 1). Mean systolic blood pressure (SBP) and diastolic blood pressure (DBP) of cases were 120.1±9.3 mm Hg and 80.1±7.0 mmHg respectively, was not statistically significant than those of controls 118.2±9.0 mmHg and 79.3±6.1 mmHg, respectively (p=0.14 and 0.38 respectively; Table 1). Mean serum HDL-C level was low and statistically significant compared to controls (40.1±7.8 mg/dl and 43.2±10.3 mg/dl; p=0.017) (Table 1). Mean serum TG levels were higher in controls (121.8±52.7 mg/dl) than in cases (111.3±53.3 mg/dl) however was not statistically significant (p=0.16; Table 1). Mean fasting plasma glucose levels were significantly higher in patients (89.2±8.1 mg/dl) than in controls

(85.8±9.2 mg/dl) (p=0.008; Table 1). FI level was taken as surrogate marker for IR. Mean FI levels were statistically significant between cases and controls (9.3±8.3 µIU/mL and 6.8±5.6 µIU/mL respectively; p=0.013) (Table 1) IR was found in 76% of cases which was significantly higher than in controls (p<0.05; Table 1) MetS was observed 29% in cases and 18% in controls, this difference that was not statistically significant (p=0.06; Table 1).

There was no significant difference in mean age of patients in the papulosquamous groups. Mean BMI was comparable among the different groups (p=0.75; Table 2). The mean waist circumference, SBP and DBP, serum TG observations did not significantly differ between the papulosquamous groups (p=0.092, 0.578, 0.956 and 0.981 respectively; Table 2). The mean plasma glucose levels among groups were significantly different, (p=0.018; Table 2). On post hoc testing, it was observed that mean plasma glucose level was higher in LP compared to PRP group (p=0.035). Mean serum HDL-C levels were statistically significantly between the groups (p=0.031; Table 2). FI level was significantly different between groups (p=0.047; Table 2) On post hoc testing, mean FI level was higher in LP compared to PRP group (p=0.049).

IR was highest in psoriasis 29% followed by LP 22%, PRP 19%, and LS 6% which was statistically significant (p<0.05). MetS was mostly found in psoriasis (17%), LP (9%) and least in PRP, LS (2% and 1% respectively).

However, there was no statistically significant difference among the papulosquamous groups (p=0.518; Table 2). There is a positive correlation between IR and MetS (r=0.85, p<0.05).

Table 1: Study parameters in cases and controls, (n=100).

Parameters	Cases, n (%)	Controls, n (%)	Statistical analysis
Age (Years)	44.1 (4.0)	43.2 (3.2)	T=1.75; p=0.080
BMI (kg/m^2)	22.8 (4.0)	23.6 (3.0)	T =1.60; p=0.111
Waist circumference (cm)	89.1 (8.2)	87.2 (7.4)	T =1.72; p=0.087
SBP (mmHg)	120.1 (9.3)	118.2 (9.0)	T =1.46; p=0.143
DBP (mmHg)	80.1 (7.0)	79.3 (6.1)	T =0.86; p=0.389
Serum HDL-C (mg/dl)	40.1 (7.8)	43.2 (10.3)	T =2.39; p=0.017*
Serum triglycerides (mg/dl)	111.3 (53.3)	121.8 (52.7)	T =1.40; p=0.162
Fasting plasma glucose (mg/dl)	89.2 (8.1)	85.8 (9.8)	T =2.67; p=0.008*
Fasting plasma insulin (µIU/mL)	9.3 (8.3)	6.8 (5.6)	T=2.49; p=0.013*
Insulin resistance (%)	76	34	χ^2=35.63; p<0.05*
Metabolic syndrome assessed by NCEP-ATP III (%)	29	18	χ^2=3.36; p=0.066

cm=centimeters, body mass index (BMI=weight in kilograms divided by height in meters squared); SBP-Systolic blood pressure, DBP-Diastolic blood pressure; HDL-C=High density Lipoprotein-cholesterol, mean (SD) [95% CI]; * P<0.05 is significant.

Table 2: Study parameters in papulosquamous group of diseases.

Parameters	Psoriasis, (n=48) (%)	Lichen planus, (n=37) (%)	Pitirisis rubra pilaris, (n=12) (%)	Lichen striatus, (n=3) (%)	Statistical analysis
Age (Years)	43.0 (3.4)	42.2 (3.1)	41.1 (3.5)	38.6 (3.2)	F=2.51; p=0.063
BMI (kg/m^2)	23.0 (4.8)	23.4 (3.8)	22.2 (3.9)	22.5 (2.7)	F=0.25; p=0.857
Waist circumference (cm)	87.1 (6.3)	88.0 (7.1)	87.7 (7.8)	88.9 (8.5)	F=0.16; p=0.920
SBP (mmHg)	117.8 (7.6)	120.2 (8.1)	118.9 (9.9)	117.0 (9.2)	F=0.65; p=0.578
DBP (mmHg)	80.2 (6.6)	79.5 (5.1)	80.2 (6.2)	79.6 (6.2)	F=0.10; p=0.956
Serum HDL (mg/dl)	45.1 (6.1)	39.9 (10.3)	43.8 (5.9)	44.3 (7.4)	F=3.06; p=0.031*
Serum triglycerides, (mg/dl)	122.1(64.3)	120.9 (43.8)	116.3 (59.0)	111.9 (49.1)	F=0.04; p=0.986
Fasting plasma glucose (mg/dl)	89.9 (6.8)	91.4 (5.9)	85.1 (9.0)	82.9 (11.3)	F=3.50; p=0.018*
Plasma insulin (µIU/ml)	8.9 (3.8)	9.3 (3.9)	5.8 (5.0)	6.2 (5.3)	F=2.74; p=0.047*
IR (%)	29	22	19	6	χ^2=18.06; p<0.05*
Metabolic syndrome assessed by NCEP-ATP III (%)	17	9	2	1	χ^2=2.26; p=0.518

cm=centimeters, body mass index (BMI=weight in kilograms divided by height in meters squared); SBP-Systolic blood pressure, DBP-Diastolic blood pressure; HDL-C=High density lipoprotein-cholesterol, mean (SD) [95% CI]; * P<0.05 is significant.

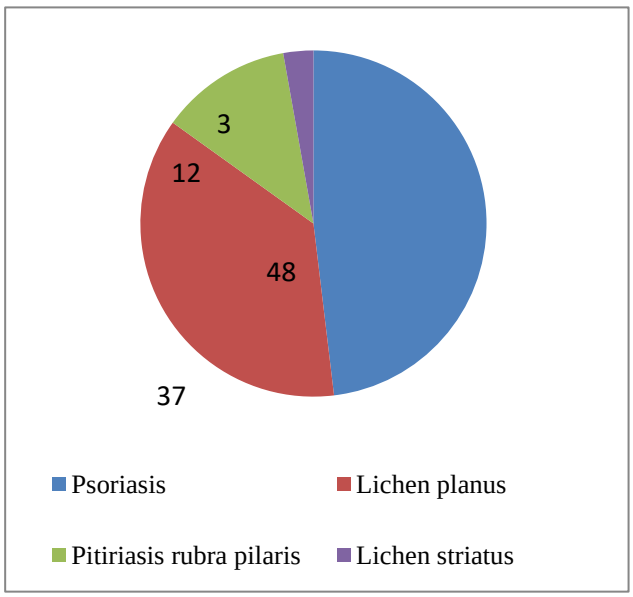

Figure 1: Distribution of papulosquamous diseases.

DISCUSSION

In recent times non communicable diseases have escalated and become a challenging task for health care system. MetS is the current scientific interest, it comprises of risk factors which predispose to CVD and T2DM. This cascade of reaction happens when there is insulin imbalance which affects all other systems of the body.[8] The impact of it relies not only on the burden of IR per se, but also influenced by genetic, sedentary lifestyle and environmental factors.

This study was done to evaluate components of MetS and IR association in papulosquamous group of diseases. We did not find any significant statistical differences in BMI, waist circumference, blood pressure and serum TG between cases and controls. Neither there was any significant difference in the above parameters among the papulosquamous disease groups. In our study controls were marginally overweight compared to cases but was not statistically significant. In congruent to Hashba et al study, wherein patients without MetS 28.8% (n=13) were overweight and none was obese.[9] It should be emphasized that, in the current scenario even non obese patients are diagnosed with MetS. They are termed as metabolically obese due to increased visceral fat accumulation in them.[10]

The prevalence of MetS in different parts of India varies from 11-41%.[11] Wilson et al reported that patients with MetS, one-third developed CAD and half of the patients developed T2D over a period of 8 years follow-up.[12] A study conducted among urban population from South India reported a 27% of prevalence of MetS, with 26.4% in males and 28.1% in females.[13] Similarly, in this study, 29% of cases had MetS which was not significantly different from 18% controls.

We also found MetS in 17% psoriasis, 9% LP, 2% PRP and 1% in LS but none of these was statistically significant. In contrast, studies conducted by Kokpol et al and Owczarczyc-Suczonek et al found higher prevalence of MetS in psoriatic patients than the general population. (49.25% vs 30.65% and 25.81% vs 21.02% respectively).[14,15] In a cross-sectional study conducted by Hashba et al in 70 clinically diagnosed patients with LP for 1 year found 35.7% prevalence of MetS. There was a higher prevalence of central obesity, increased fasting blood sugar and low HDL-C in patients.[9] Whereas we observed, the components of MetS like hyperglycemia, low HDL-C which were significantly higher in the cases than controls.

Insulin is a pancreatic hormone produced by islets of Langerhans with a molecular weight of 5808 Da and it is composed of 51 amino acid residues.[16] Basal insulin represents 45% to 50% of daily insulin and the FI level approximates basal insulin.[17] IR is reduced physiological response of peripheral tissues to insulin. In normal populations, IR occurs in 20 to 25% of the individuals.[18] It is important to identify the individuals who are at risk of IR for primary prevention of non-communicable diseases.[16]

In the current study, FI levels were significantly higher in cases (9.3±8.3) compared to controls (6.8±5.6). IR was higher in psoriasis 29%, LP 22%, compared to PRP 19% and LS 6%. We also found IR and MetS had a positive correlation in papulosquamous diseases ($r=0.85$; $p<0.05$). According to Cho et al higher IR index assessed by the HOMA-IR value is positively associated with an increase in abnormalities in each component of MetS.[19] Sung et al has shown in healthy Asian subjects that, 8.5% developed MetS over a 5 years and elevated FI levels predicted development of subsequent MetS even in patients without MetS at baseline.[20]

Psoriasis is a chronic inflammatory skin disease affecting 1-3% of the population.[21] Recently, co-morbidities like cardiovascular, diabetes, MetS and malignancies have been described in psoriasis.[22] The prevalence of MetS has been estimated to be 15-25% in the general population and significantly higher (an increase by about threefold) in psoriatic patients, as documented earlier in literature.[8] Gisondi et al and Cohen et al also found significant association between MetS and psoriasis patients.[23,24]

Praveenkumar et al investigated the association of MetS and its components in 30 patients with chronic plaque psoriasis. They found MetS was more common in psoriatic patients than in controls but statistically insignificant (60% vs. 40%, $p=0.12$). Cases had higher prevalence of elevated blood glucose levels and higher waist circumference compared to controls. The prevalence of low HDL levels was significantly higher in cases compared to controls (86.7% vs. 60%, $p=0.02$).[21] In contrary, the prevalence of MetS, IR and lipid

abnormalities in patients with psoriasis aged 30 to 49 years is similar to that of the general adult population of Poland.[15] The above quoted studies show varying results in association between psoriasis and MetS. The risk factors such as altered lipid and glucose levels, IR were more prevalent in psoriasis, though differences were not statistically significant in our study.

LP is a T-cell-mediated chronic inflammatory disorder affecting 0.22-5% of population worldwide.[9] Inflammation in LP produces disturbance in lipid metabolism such as increase serum TG or lower HDL-C which poses a threat to CVD.[25] NCEPATP-III specifications for MetS was met by 9% of LP cases and was comparative to other papulosquamous groups. The components of MetS like lower HDL-C and higher Glucose levels were statistically significant compared to other papulosquamous groups. Similarly, a study by Vidya et al ATP-III criteria for MetS were met by 6% of the patients with LP versus 2% of the controls.[26] The present study findings were similar to Arias-Santiago et al observations on MetS in LP cases.[25]

In contrast, Baykal et al. found that among the various MetS parameters, fasting blood glucose and DBP were seen to be significantly higher in patients with LP.[27] In a cross-sectional study conducted in north Kerala, 25 patients (35.7%) enrolled in the study with LP were found to have MetS, elevated fasting blood glucose in 38 (54.3%), hyper TG in 24 (34.3%), and decreased HDL-C in 21 (56.8%).[9] Another Indian study also observed similar findings, total cholesterol, TG, HDL-C, LDL-C, and FBS values were significantly higher in LP cases than in controls.[28] Insulin itself has a lipolytic effect, where increased levels of insulin lead to increased lipolysis, in turn increases FFA levels and further promoting IR. In addition, decreased HDL-C is caused by decrease in the cholesteryl ester content of lipoprotein core.[8]

Previous studies done by Lowe et al, Seyhan et al and Atefi et al have shown significantly altered glucose levels in LP which is in comparison with our study.[29-31] We also noted raised FI levels suggesting IR in 22% of LP cases. Though there are few case control studies related to dyslipidemia and MetS in LP, but studies pertaining to IR are limited. This is most widely accepted theory for the pathophysiology of IR. The muscle, fat and liver cells do not respond to insulin and disturbs glucose absorption from bloodstream. Beta cells of pancreas initially try to produce more insulin to achieve euglycemia. Progressively, pancreas fails to keep up with the increased demand for insulin and excess glucose builds up in the bloodstream.[32]

Th1 and Th17 lymphocytes and pro-inflammatory cytokines (such as TNF-α, IL-1, IL-6, IL-17) play a decisive role in the pathogenesis of papulosquamous diseases, development of IR and also in forming atherosclerotic plaques formation.[15] The plausible hypothesis postulates that chronic systemic inflammatory disease results in IR by down regulation of insulin receptors. In addition, there is decreased expression of insulin receptors in endothelial cells results in reduction of nitric oxide (NO), a vasodilatory agent. Thus, vasoconstriction ensues leading to increased arterial stiffness following which myocardial infarction (MI) and stroke has been reported.[8] Chronic inflammation leads to atherosclerotic and metabolic disorders and vice versa. Therefore, the concept of 'inflammation march' has been proposed.[15]

Chronic inflammation of papulosquamous diseases along with genetic and lifestyle factors leads to down regulation of insulin receptors in turn predisposes to IR and MetS. Through screening of these patients by clinicians for risk factors may unravel even suboptimal managed cases of CVD and T2D. Regular follow up every six months for severe (on treatment), and yearly for mild cases. Further imparting knowledge on lifestyle modification like healthy dietary habits, smoking and alcohol restriction with regular physical exercises should be adhered strictly.

The strength of our study includes: subjects were recruited from hospital outpatient dermatology department were relatively healthy with a common ethnic, residential, socioeconomic and environmental background. Thus, limiting the effect of these confounding factors in our study. Secondly, we recorded anthropometric measurements by a single observer to reduce bias and standardized laboratory examination protocols to void errors. Lastly, we excluded patients on drugs (oral hypoglycemic, anti-lipidemic) which alter parameters recorded in our study. However, to the best of our knowledge, ours is the only study that has evaluated MetS and IR in papulosquamous group of diseases.

This study has several limitations. The Euglycemic insulin clamp is the ideal method for IR diagnosis. We did not use this method due to complexity and cost. In our study, IR was based on FI levels as it is easy to use in large populations. It is a hospital based cross sectional study does not allow its implications on general population. We did not include sedentary life variables like dietary intake and physical activity which might have an influence on IR and MetS. Thus, deregulation of skin physiology can predispose to MetS and viceverse.[8] Chronic inflammation and IR leads to increase in proinflammatory cytokines. Further research is needed in elucidation of these molecules level as a link in IR, MetS and in other dermatological diseases. A large population based prospective studies with follow-up will help to bridge this knowledge gap.

CONCLUSION

MetS and IR was found in cases with papulosquamous diseases. Increased fasting glucose level, raised FI and low HDL-C were the significant parameters in our study. IR has a positive correlation with MetS. High FI levels

indicate IR which in turn increases susceptibility to MetS. MetS is associated with insidious onset of symptoms with varied presentation depending on topography and ethnic origins leading to delayed detection. So, papulosquamous diseases can be considered as an external marker for tracing IR and MetS. It aids in detection of subclinical cases, early intervention with lifestyle modifications leads to reduction in mortality. The clinicians should be vigilant about these dermatology findings, screen for Met S and IR in their routine clinical practice.

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