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# Cardiovascular Disease in Inflammatory Disorders – Psoriasis and Psoriatic Arthritis

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## 1. Introduction

Psoriasis, a papulosquamous skin disease, was originally thought to be a disorder primarily of epidermal keratinocytes, but is now recognised as one of the commonest immune-mediated disorders. It is a chronic skin disorder that causes areas of thickened, inflamed, red skin, often covered with silvery scales. Worldwide psoriasis prevalence rates range from 0.6 percent to 4.8 percent. Children and adolescents can develop psoriasis, but it occurs primarily in adults. There seem to be two peaks in onset: one between ages 20 and 30 and another between 50 and 60. Women and men are equally affected. The immune system is involved and appears to be overactive in a way that causes inflammation. Specifically, there is excessive production of T-Helper 1 cytokines, particularly TNF $\alpha$ . These have many effects, including growth of extra blood vessels within the skin and increased turnover of the skin cells. Like most diseases, psoriasis is influenced by inherited characteristics. Up to 50% of people with psoriasis will know of another affected family member. Patients with a family history of psoriasis tend to develop psoriasis earlier in life than those without a family history.

It is associated with comorbidities that include metabolic syndrome and increased cardiovascular risk. These conditions share etiologic features and health consequences that directly correlate with the severity of psoriatic disease. Up to thirty percent of patients with psoriasis develop psoriatic arthritis, this is an erosive, seronegative arthritis, which is associated with inflammation of tendon insertion points (enthesitis). An increased risk of cardiovascular disease was first noted in patients with rheumatoid arthritis and it became apparent that chronic inflammation was associated with increased risk of cardiovascular or cerebrovascular disease.

While heart disease remains a quiet killer, psoriasis is a visible disease whose impact on social interaction and quality of life usually prompt earlier physician consultation. Psoriasis patients are at increased risk of being obese and therefore are at greater risk than the general population to develop myocardial infarction, metabolic syndrome and other comorbidities. It has become evident that patients with psoriasis and psoriatic arthritis have an increased incidence of cardiovascular disease and also certain cardiovascular risk factors such as smoking, hypertension and metabolic syndrome compared to the normal population. They also have increased non-conventional risk factors such as raised levels of homocysteine and excessive alcohol consumption.

## 2. Psoriasis, psoriatic arthritis and cardiovascular disease

An association between psoriasis and cardiovascular risk was first described in 1978. Patients with psoriasis in an outpatient clinic had 2.2 times higher incidence of venous and arterial vascular disease in a clinic-based control study (McDonald & Calabresi, 1978). Gelfand and colleagues published a large cross-sectional study of the UK General Practice Database reporting a higher death rate from cardiovascular disease in those with severe psoriasis compared to the general population (Gelfand et al., 2006). The investigators controlled for diabetes, hyperlipidaemia, hypertension, body mass index, age, sex and smoking and found that psoriasis appeared to confer an independent risk for myocardial infarction. This risk is greater in younger patients (Gelfand et al., 2006). A second group utilising the same data found an increased incidence of risk factors for cardiovascular disease, as well as increased rates of myocardial infarction, angina, stroke and peripheral vascular disease (Henseler & Christophers, 1995). Patients were also found to have an increased risk of cardiovascular mortality that is independent of traditional cardiovascular risk factors (Mehta et al., 2010). More recently, a study has shown that psoriasis conferred an additional 6.2% absolute risk of 10 year major adverse cardiac events after adjusting for age, gender, diabetes, hypertension, tobacco use and hyperlipidaemia (Mehta et al., 2011).

A hospital based study from Sweden, Germany and Finland previously documented increased rates of risk factors such as hypertension, diabetes and obesity in patients with psoriasis. Poikolainen and Mallbris found that patients with severe psoriasis who required hospitalisation for treatment of their psoriasis had increased mortality from cardiovascular disease (Mallbris et al., 2004; Poikolainen et al., 1999). Patients managed as out-patients however did not have excess risk, suggesting that more severe disease was associated with a higher risk of cardiovascular disease. In a Danish nationwide cohort study, psoriasis was shown to be associated with increased risk of adverse cardiovascular events and all cause of mortality especially in young patients with severe disease (Ahlehoff et al., 2011). Furthermore, a separate Danish study showed that psoriasis significantly impaired prognosis in patients after myocardial infarction (Ahlehoff et al., 2011).

An observational study by Prodanovich and colleagues examined the cardiovascular risk factors in psoriasis and found psoriasis to be associated with atherosclerosis and this association applies to coronary artery, cerebrovascular and peripheral vascular diseases (Prodanovich et al., 2009). A cross sectional prevalence-based study from 2 American healthcare databases showed an increase prevalence of cardiovascular diseases and risk factors in patients with psoriasis compared with general population (Kimball et al., 2008). In Israel, Shapiro and colleagues showed a strong association between psoriasis, atherosclerosis, heart failure and diabetes (Shapiro et al., 2007). In addition to large clinical studies, several studies have documented subclinical cardiovascular disease.

A Chinese study showed that young patients with psoriasis have increased arterial stiffness compared with healthy controls. More importantly, CRP positively correlated with, and independently predicted, arterial stiffness. This suggests that systemic inflammation in patients with psoriasis is associated with premature atherosclerosis (Yiu et al., 2011). In another Asian study, Mazlan and colleagues also showed that there was a significant association between cardiovascular risk and intima-media thickness in psoriatic arthritis patients. However, it was not associated with disease activity, disease severity and DMARDS therapy (Mazlan et al., 2009). Karadag and colleagues demonstrated a significant

endothelial dysfunction and increased insulin resistance in patients with psoriasis (Karadag et al., 2010). In a separate Turkish study, aortic elasticity in patients with psoriasis was found to be significantly lower than the control group. In psoriatic patients without cardiac involvement, aortic elasticity was decreased and this decrease was correlated with the duration and severity of the disease (Bicer et al., 2009). A study by El-Mongey and colleague showed an increase in carotid artery intima-media thickness in patients with chronic psoriasis suggesting that chronic psoriasis is associated with subclinical atherosclerosis with increased risk of cardiovascular disease (El-Mongy et al., 2010). Patients with psoriatic arthritis also had a higher prevalence of subclinical atherosclerosis as measured by intima-media wall thickness (Eder et al., 2008; Kimhi et al., 2007) and endothelial dysfunction even without any overt cardiovascular disease (Gonzalez-Juanatey et al., 2007). More recently, subclinical left ventricular dysfunction has also been shown in psoriatic arthritis patients who had no established cardiovascular disease or risk factors (Shang et al., 2011). Risk factors for cardiovascular disease as well as other vascular diseases were shown by Kaye and colleagues to occur with higher incidence in patients with psoriasis than in the general population (Kaye et al., 2008). The study by Jamnitski and colleague showed the prevalence of cardiovascular diseases in psoriatic arthritis resembles that of rheumatoid arthritis (Jamnitski et al., 2011).

There are several theories to explain the association between psoriasis and increased cardiovascular risk. Both psoriasis and atherosclerosis involve Th-1 lymphocytes and cytokines and it is suggested that the excess inflammatory cells and mediators produced in psoriasis may contribute to the development of atherosclerotic plaques. A recent case-control study in 2011 on inpatients with psoriasis and dermatitis by Shapiro and colleagues supports previous reports of an association between psoriasis and CVD risk factors, suggesting that the inflammatory process in psoriasis, but not in dermatitis which is a T helper-2 mediated condition is involved in atherosclerosis (Shapiro et al., 2011). Subsequently, Armstrong and colleagues have investigated the different inflammatory pathways which are common in psoriasis and atherosclerosis. They have found that psoriasis and atherosclerosis are diseases in which effector T lymphocytes such as Helper T cells type 1 (Th1) and 17 (Th17) play integral roles in disease pathogenesis and progression. Regulatory T cells (Treg) also exert clinically important anti-inflammatory effects that are pathologically altered in psoriasis and atherosclerosis. These shared pathways provide the basis for mechanisms that may explain the epidemiologic observation that patients with psoriasis have an increased risk of heart disease (Armstrong et al., 2011).

In patients with psoriatic arthritis, it was shown recently that better control of inflammation with TNF-alpha blockers may inhibit the cascade that causes raised vascular risks in this cohort of patients. They were found to have thinner carotid intima-media thickness compared to those who were treated with DMARDs (Di Minno et al., 2011). With these findings, it is possible that control of chronic inflammation in these patients may have a significant role in preventing vasculopathy. Apart from this, screening and modification of other cardiovascular risk factors in these patients should form part of their assessment.

Cardiovascular risk factors found with increased frequency in patients with psoriasis include conventional cardiovascular risk factors such as obesity, diabetes mellitus, hypertension, dyslipidaemia and smoking. Oxidative stress, endothelial cell dysfunction,

abnormal platelet adhesion and hyperhomocysteinemia which may also increase cardiovascular risk have all been reported to occur with greater prevalence in psoriasis.

### **3. Conventional risk factors in psoriasis**

#### **3.1 Smoking and psoriasis**

Smoking and psoriasis have been associated by several studies and from the disease perspective, it appeared to have an adverse effect with treatment response and patients in this cohort seem to have more severe disease. There is an increased rate of smoking in patients with psoriasis compared to controls (Christophers, 2001; Griffiths & Barker, 2007; McDonald & Calabresi, 1978; Stern et al., 2004; Veale & Fitzgerald, 2002). Poikolainen and colleagues found that smoking is a risk factor for psoriasis in women. Negative life events and smoking were more common among psoriasis patients than among controls (Poikolainen et al., 2004). Furthermore, the risk for psoriasis was higher in ex-smokers and current smokers compared to individuals who had never smoked (Mills et al., 1992; Naldi et al., 1999, 2005; Poikolainen et al., 2004; Williams, 1994).

Behnam and colleagues found that women who are smokers have an up to 3.3-fold increased risk of developing plaque-type psoriasis. Men who are smokers do not exhibit such an increased risk, but studies have shown that smoking more than 10 cigarettes per day by men who are psoriasis patients may be associated with a more severe expression of disease in their extremities. In addition, smoking among both men and women who are psoriasis patients has been shown to reduce improvement rates (Behnam et al., 2005). Smoking also adversely affects the natural history of psoriasis in both genders especially in those who smoked more than 20 cigarettes a day. An Italian hospital-based cross-sectional study by Fortes and colleagues showed high intensity of smoking (>20 cigarettes daily) vs a lower level of consumption (< or =10 cigarettes daily) was associated with a more than 2-fold increased risk of clinically more severe. Separate analyses for men and women showed that the effect of cigarette-years was stronger for women (Fortes et al., 2005). Therefore, patients with psoriasis who smoke tend to have a less favourable outcome and disease that is more difficult to control.

Some researchers have found that heavier smokers have a greater risk of developing psoriasis and this only falls back to normal 20 years after quitting. There are good reasons for these patients to cease smoking to improve their psoriasis and more importantly, for their general health (Behnam et al., 2005; Fortes et al., 2005; Setty et al., 2007).

#### **3.2 Hypertension and psoriasis**

The association between elevated blood pressure and psoriasis was first described in 1977 and further studies showed an increased prevalence of essential hypertension in patients with psoriasis (Gisondi et al., 2007). In these patients, their hypertension is likely to be more severe and requires more medication to control it.

Enhanced activity of the renin-angiotensin system (Cohen et al., 2008) and increased levels of endothelin-1 released from vascular endothelium (Binazzi et al., 1975) were factors that contribute to the increased incidence of hypertension in patients with psoriasis. More recently, a hospital-based case-controlled study by Armesto and colleague evaluated the

prevalence of hypertension in psoriasis based on a sample of Spanish population. The prevalence of hypertension was significantly higher in psoriasis patients than controls (Armesto et al., 2011). Armstrong and colleague showed that compared to hypertensive patients without psoriasis, psoriasis patients with hypertension were 5 times more likely to be on a monotherapy antihypertensive regimen, 9.5 times more likely to be on dual antihypertensive therapy, 16.5 times more likely to be on triple antihypertensive regimen, and 19.9 times more likely to be on quadruple therapy or centrally-acting agent (Armstrong et al., 2011).

### 3.3 Dyslipidaemia and psoriasis

Several mechanisms including unhealthy lifestyle, activation of T Helper-1 lymphocytes and autoantibodies recognizing oxidized low-density lipoprotein may induce dyslipidaemia in psoriatic patients. Moreover, the levels of antibodies against oxidized low-density lipoprotein correlate with the disease activity. A large study on lipid profile at the onset of psoriasis showed significantly higher very low-density lipoprotein and high density lipoprotein fractions (Mallbris et al., 2006). This study was controlled for gender, blood pressure, BMI, physical activity, smoking and alcohol consumption. Later, a large cross-sectional study using a population-based database by Dreiherr and colleagues found that psoriatic patients had higher triglyceride and lower high-density lipoprotein cholesterol levels compared to control (Dreiherr et al., 2008).

In a separate study, children with psoriasis were found to have elevated total plasma cholesterol and HDL cholesterol and a decrease in the ratio of HDL to LDL cholesterol (Ferretti et al., 1993, 1994). Dyslipidaemia observed in patients with psoriasis is compounded by increased oxidative stress and decreased anti-oxidant capacity. Autoantibodies recognizing oxidized LDL have been found in psoriasis, with their levels correlating with disease activity as measured by PASI (Offidani et al., 1994).

More recently, it has been suggested that statin therapy may have beneficial effects by downregulating lymphocyte function-associated antigen-1, inhibiting leukocyte endothelial adhesion, extravasation and natural killer cell activity, all of which are key to the development of psoriasis lesions. They also reduce levels of proinflammatory cytokines such as tumour necrosis factor- $\alpha$ , interleukin 1 and 6, lowering C-reactive protein promote T (H) 1 cytokine receptors on T cell, leading to inhibition of activation of lymphocytes and infiltration into inflammatory sites.

Overall, statin therapy for associated dyslipidaemia in patients with psoriasis has shown clinical improvement due to its immunomodulatory and anti-inflammatory effects (Ghazizadeh et al., 2011).

### 3.4 Diabetes mellitus and psoriasis

The association between psoriasis and hyperglycaemia was documented as early as 1967 (Lynch, 1967). Since then, numerous studies have confirmed the association between psoriasis, hyperglycaemia and relative insulin resistance (Fratino et al., 1979; Neimann et al., 2006; Pelfini et al., 1979; Reynoso-von Drateln et al., 2003; Sommer et al., 2006). A cross-sectional study by Ucak and colleagues found that psoriatic patients were more insulin resistant than healthy subjects and type II psoriatics (late onset) were more susceptible than

type I psoriatics (onset before 35 years of age) to develop impaired glucose tolerance (Ucak et al., 2006). Qureshi and colleagues found that women with psoriasis were 63% more likely to develop diabetes and around 17% more likely to develop hypertension, than women without psoriasis (Qureshi et al., 2009). Genetic analysis of two non-major histocompatibility complex (MHC) in patients with psoriasis found the strongest phenotypic marker for a loci mapping to chromosome 6p22. This marker maps to CDKAL1, a gene associated to type 2 diabetes, suggesting a possible role for pleiotropic susceptibility loci for both conditions (Wol et al., 2008).

Boehncke and colleagues found a significant correlation between the Psoriasis Area and Severity Index (PASI) score and insulin secretion. The PASI score was significantly correlated with serum resistin levels, a cytokine known to be increased in insulin resistance (Boehncke et al., 2007). Patients with psoriasis demonstrate hyperinsulinaemia which correlates with disease severity (Boehncke et al., 2007; Ucak et al., 2006) and increased levels of insulin results in excessive levels of insulin-like growth factors (IGF) which appear to have a role in epidermal hyperproliferation in psoriasis (Hodak et al., 1996; Wraight et al., 2000; Xu et al., 1996). Induction of interleukin-6 and vascular endothelial growth factor has been postulated as underpinning IGF's role in the development of psoriatic plaques (Kwon et al., 2000, 2004).

More recently, a cohort analysis by Solomon and colleagues on patients with psoriasis showed a reduced risk of diabetes mellitus (DM) with the use of a tumor necrosis factor  $\alpha$  (TNF- $\alpha$ ) inhibitor or hydroxychloroquine, but not with methotrexate, compared with other nonbiologic disease-modifying antirheumatic drugs (DMARDs). Evidence suggests a possible role for DMARDs and immunosuppression in DM prevention (Solomon et al., 2011) along with adopting a healthy lifestyle, regular physical activity and good nutrition.

### 3.5 Obesity and metabolic syndrome in psoriasis.

In a case control study, we found that patients with psoriasis had higher Body Mass Index (BMI) compared to controls (Tobin et al., 2011). Individuals with psoriasis were more likely than controls to be obese. An increased adiposity and weight gain were strong risk factors for the development of psoriasis. A case-controlled study by Chen and colleagues found high levels of leptin more often in females, the obese and those with high blood pressure, metabolic syndrome and psoriasis. Hyperleptinemia in psoriasis is associated with higher risk of developing metabolic syndrome, which may be defined as the concurrence of hypertension, dyslipidaemia, diabetes and central adiposity. This finding links the chronic inflammation of psoriasis with metabolic disturbances. The high circulating leptin levels in individuals with psoriasis may derive not only from fat tissue but also from inflammation (Chen et al., 2008). Body weight loss has been reported to significantly decrease leptin levels and improve insulin sensitivity and may reduce the likelihood of developing metabolic syndrome and adverse cardiovascular diseases. Psoriasis and obesity are linked through a common pathophysiological mechanism of chronic low grade inflammation. Not only is obesity associated with a higher incidence of psoriasis and greater severity, it also affects response to treatment. Weight loss could potentially become part of the general treatment of psoriasis, especially in patients with obesity.

Furthermore, when age, smoking and alcohol intake were all controlled for, there was a strong association between BMI and psoriasis (Setty et al., 2007).

Metabolic syndrome has been reported to be strongly associated with psoriasis. A hospital-based case-control study by Gisondi and colleagues showed a higher prevalence of metabolic syndrome in patients with psoriasis. These patients were found to be older and had longer disease duration compared with those without metabolic syndrome. However, there was no correlation between disease severity and prevalence of this syndrome (Gisondi et al., 2007). Another case-control study by Cohen and colleagues showed metabolic syndrome was more common in male psoriatic patients who are above 50 years of age (Cohen et al., 2008). Management of these patients should also target these metabolic conditions associated with psoriasis which are significant predictors of a cardiovascular event. Therefore, healthy diet and lifestyle should be emphasized.

#### **4. Conventional risk factors in psoriatic arthritis**

There is less research on cardiovascular disease and risk factors in psoriatic arthritis compared to psoriasis but it has been shown that patients with psoriatic arthritis have an increased prevalence of cardiovascular risk factors, type 2 diabetes, hyperlipidaemia and hypertension.

A slightly different pattern of dyslipidaemia was found in these patients. They had higher HDL cholesterol and apolipoprotein A1 levels, lower total cholesterol and low density lipoprotein cholesterol levels and lower total cholesterol to HDL cholesterol ratio (Tam et al., 2008). Older studies have shown that psoriatic arthritis patients with synovitis had lower total cholesterol, low density lipoprotein (LDL) and high density lipoprotein (HDL) (Lazarevic et al., 1992; Skoczynska et al., 2003).

Individual components of metabolic syndrome such as hypertension, obesity, insulin resistance and dyslipidaemia (Jones et al., 2000; Tam et al., 2008) have been reported in psoriatic arthritis patients but the full spectrum of metabolic syndrome has not been studied in these patients.

#### **5. Non-conventional risk factors in psoriasis and psoriatic arthritis**

##### **5.1 Inflammation**

Chronic inflammation is known to play a role in the development of atherosclerosis involving the innate immune system and T helper-1 lymphocytes (Hansson et al., 2002, 2006). This is similar to the pattern of immune mediated inflammation seen in psoriasis and with chronic low grade circulating inflammatory cells and cytokines which invoke endothelial inflammation, could ultimately lead to plaque formation (Wakkee et al., 2007). The increase prevalence of obesity in psoriasis and psoriatic arthritis may also increase the burden of inflammation (Hammonds et al., 2006).

C - reactive protein is a moderate predictor for cardiovascular disease (Danesh et al., 2004) and a marker that correlates well with joint inflammation. However, a large Italian study showed that it is more valuable in severe joint disease (Cervini et al., 2005). In another study, raised plasma fibrinogen levels are shown to be associated with an increased risk of vascular events. This may be mediated by adverse effects of fibrinogen on plasma viscosity, coagulation, platelet activity, inflammation and atherogenesis (Dziedzic, 2008; Kakfika et al., 2007). It is also known to be elevated in psoriasis and psoriatic arthritis (Marongiu et al.,

1994; Rocha – Pereira et al., 2004; Vanizor Kural et al., 2003). This would indicate chronic inflammation and a possible role in increasing cardiovascular risk.

## **5.2 Endothelial dysfunction**

Patients with psoriasis were found to have increased calcification in their coronary arteries compared to controls. Ludwig and colleagues found a significantly increased prevalence and severity of coronary artery calcification in patients with psoriasis and is likely to be an independent risk factor (Ludwig et al., 2007). Chronic inflammation causes endothelial dysfunction which leads to formation of atherosclerotic plaques in association with raised plasma lipids. Increased levels of oxidized low density lipoprotein in psoriatic plaques have been reported compared to controls (Rocha – Pereira et al., 2004; Vanizor Kural et al., 2003). Oxidized low-density lipoprotein is thought to promote atherosclerosis through complex inflammatory and immunologic mechanisms that lead to lipid dysregulation and foam cell formation. Recent findings suggested that oxidized LDL forms complexes with beta2-glycoprotein I (beta2GPI) and/or C-reactive protein (CRP) in the intima of atherosclerotic lesions. Oxidative stress has a critical role in causing damage to endothelial cells (Matsuura et al., 2006).

## **5.3 Fibronectin and platelets: Atherothrombotic markers**

Atherothrombosis results in myocardial infarction, stroke and peripheral vascular disease. Low levels of fibronectin have been suggested as a marker of atherothrombosis and this has been shown in patients with psoriasis with active disease and in remission (De Pita et al., 1996). Increased platelet aggregation has also been found in these patients compared to controls. Hayashi and colleagues found platelet aggregation was significantly increased in psoriatics compared with normal controls. An additive effect was observed when diabetes was associated with psoriasis, with platelet aggregation being further increased by ADP. The increased platelet aggregation with ADP and epinephrine was significantly reduced when the skin lesions had cleared (Hayashi et al., 1985).

## **5.4 Homocysteine**

Homocysteine causes endothelial dysfunction and is an independent risk factor for development of cardiovascular disease (Graham et al., 1997). In a case controlled study we showed that psoriatic patients have a relative risk 7.1 times greater than controls of having significantly raised levels of homocysteine (Tobin et al., 2011). This was also found in 2 uncontrolled studies and one in the context of patients who are taking methotrexate (Vanizor Kural et al., 2003). Refsum and colleagues investigated the effect of low-dose methotrexate on plasma homocysteine in patients who had psoriasis. Psoriasis patients had significantly higher basal plasma homocysteine levels (Refsum et al., 1989). High levels of homocysteine have been documented in small number of patients with psoriatic arthritis (Segal et al., 2004).

## **5.5 Increased alcohol consumption**

Excessive alcohol consumption has been widely documented in patient with psoriasis (Higgins, 2000) and some researchers believe that drinking large amounts of alcohol predisposes to psoriasis (Segal et al., 2004). There is a high prevalence of psoriasis in patients

with alcoholic liver disease (Tobin et al., 2009). Patients undergoing phototherapy for psoriasis also had an increased prevalence of excessive alcohol intake (Kirby et al., 2011). Treatment outcome is adversely affected in patients who consume excess alcohol (Gupta et al., 1993).

Overall, alcohol misuse is common in patients with moderate to severe psoriasis. Proper screening allows identification of these patients who would benefit from appropriate intervention. There are limited studies about alcohol consumption in patients with psoriatic arthritis.

Sporadic heavy drinking (binge drinking) increases the risk of developing coronary heart disease, the most common form of heart disease. Men nearly double their chances of developing coronary heart disease by drinking more than eight units of alcohol a day. Women have a 1.3 times greater risk of developing coronary heart disease when they drink more than six units a day. Women who persistently drink more than three units of alcohol a day and men, who drink more than four, are more likely to suffer from the risk factors associated with cardiovascular disorders such as high blood pressure. Alcohol can increase levels of homocysteine. High homocysteine levels increase the risk of thrombosis. Long-term drinking and heavy alcohol consumption is linked with weakness of the heart muscle, known as cardiomyopathy.

There is evidence to suggest that a regular pattern of drinking relatively small amounts of alcohol (one or two drinks a few times a week) reduces the risk of heart disease in men over the age of 40 and post-menopausal women. Therefore, excess amount of alcohol appear to be harmful whereas small amounts seem to be cardioprotective.

## 6. Does treatment of inflammation ameliorate cardiovascular risk?

Much has been said about the effects of chronic inflammation on cardiovascular risk factors and cardiac events. Researchers have tried to investigate if systemic therapy may improve cardiac biomarkers in patients with severe psoriasis. A German study by Boehncke and colleagues investigated the effects of continuous systemic therapy on the cardiovascular risk of patients with severe psoriasis. There was a trend towards reduced serum levels of vascular endothelial growth factor (VEGF) and resistin, while the potentially cardio-protective adiponectin showed a trend toward increased serum levels under therapy. This was parallel to improvement in C-reactive protein, PASI and insulin responsiveness (Boehncke et al., 2011). The impact on the metabolic state was found to be better if the psoriatic inflammation was controlled for longer (Boehncke et al., 2011). However, Abuabara and colleagues investigated on the effect of systemic treatment on the incidence of myocardial infarction in a control group treated with UVB therapy that has limited systemic anti-inflammatory effects. The risk of developing myocardial infarction in patients with severe psoriasis receiving systemic therapy was not reduced compared to a group undergoing phototherapy (Abuabara et al., 2011).

## 7. Conclusion

The increased cardiovascular risks in patients with psoriasis and psoriatic arthritis may be due to higher prevalence of multiple risk factors in these patient cohorts. It is very unlikely

that all patients with psoriasis and psoriatic arthritis have increased cardiovascular risks. However, steps should be taken to identify those who are at risk early for intervention. With the evidence indicating a higher incidence of metabolic syndrome and cardiovascular disease, it is important for physicians to identify at risk patients and initiate an interdisciplinary approach for the screening and management of their co - morbidities.

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## **Recent Advances in Cardiovascular Risk Factors**

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Among the non-communicable diseases, cardiovascular disorders are the leading cause of morbidity and mortality in both the developed and the developing countries. The spectrum of risk factors is wide and their understanding is imperative to prevent the first and recurrent episodes of myocardial infarction, stroke or peripheral vascular disease which may prove fatal or disabling. This book has tried to present an update on risk factors incorporating new research which has thrown more light on the existing knowledge. It has also tried to highlight regional diversity addressing such issues. It will hopefully be resourceful to the cardiologists, general practitioners, family physicians, researchers, graduate students committed to cardiovascular risk prevention.

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