Diabetic Dyslipidemia - Role of Saroglitazar

Anirban Majumder¹ and Sanjay Chatterjee²*
¹Associate Professor, Endocrinology unit, Department of Medicine, KPC Medical College, West Bengal University of Health Sciences, Kolkata, India
²Consultant Diabetologist, Apollo Gleneagles Hospital, Kolkata, India

Abstract

‘Diabetic dyslipidemia’ (combination of raised triglyceride levels, raised small-dense Low-density lipoprotein particles and low high-density lipoprotein cholesterol levels) is the most prominent risk factor of atherosclerosis and cardiovascular disease. Despite statin therapy and LDL-lowering, a high residual risk of cardiovascular events persists. High triglyceride levels and low high-density lipoprotein cholesterol levels singly and collectively increase the risk of cardiovascular events in type 2 diabetes mellitus and guidelines recommend modifying these secondary therapeutic targets to provide additional vascular protection. Addition of a fibrate or niacinare options for combination with a statin to reduce other atherogenic dyslipidemia and are clearly effective at raising high-density lipoprotein cholesterol levels and lowering triglycerides. Addition of high dose omega-3 fatty acids (2-3 gm/day) with a statin are also effective in lowering triglyceride, but their effects on cardiovascular events remain uncertain and are complicated with safety issues.

Saroglitazar is a novel dual Peroxisome Proliferator-Activated Receptors-α/γ agonist and the first glitazin approved in the world for the treatment of diabetic dyslipidemia by Drug Controller General of India in June 2013. Saroglitazar (2 mg and 4 mg) therapy has shown significant (45%) reduction in triglycerides, significant reduction of other atherogenic lipids (Low-density lipoprotein, very-low density lipoprotein, total cholesterol and apolipoprotein-B) and significant improvement of glycomic status, with relatively free from side effects. It has emerged with a hope to further reduce the incidence of cardiovascular disease among statin treated diabetic subjects. However, the trial populations were small and toxicity data may emerge with increasing use of this drug. Moreover, in absence of outcome studies and large multi-center longitudinal follow up data, the clinical cardiovascular efficacy is uncertain till date.

Keywords: Low-density lipoprotein; High-density lipoprotein; Triglyceride; Peroxisome proliferator-activated receptor

Introduction

Cardiovascular disease is the leading cause of premature morbidity and mortality worldwide [1]. The role of lipids in the causation of vascular disease is established in the past few decades and pharmacotherapy with statins, targeting to lower the Low-density lipoprotein (LDL) cholesterol has proved a particularly effective intervention strategy [2,3]. However, in spite of statin therapy and LDL-lowering, a high residual risk of cardiovascular events persists [4], drawing attention to the need for additional effective preventive measures. Although several studies have shown associations of high-density lipoprotein (HDL) cholesterol and triglyceride (TG) concentrations with vascular risk, interventions that increase HDL cholesterol or reduce TG concentrations, or both, have not consistently shown benefit [5-7].

The potential role of peroxisome proliferator-activated receptor (PPAR) agonists to positively influence the cardiovascular disease risk in type 2 diabetes mellitus (T2DM) has remained an area of continuous medical interest and there is a strong need for a safe dual PPAR-α/γ agonist with effects in both lipids and glycemic parameters. Saroglitazar, is a dual PPAR-α/γ agonist, designed to optimize glycemic control and lipid parameters (reduces TG and increases HDL), and minimize PPAR-related adverse effects in the treatment of patients with T2DM [8]. In the following review we will focus on the role of Saroglitazar in dyslipidemia, particularly in T2DM. Saroglitazar (marketed by Zyus Cadil, Ahmedabad, India in the brand name Lipaglyn) is approved by Drug Controller General of India (DCGI) for treating diabetic dyslipidemia in June 2013 [9].

Dyslipidemia and Cardiovascular Disease

Dyslipidemia is one of the most prominent risk factor of atherosclerosis, leading to cardiovascular disease. Total cholesterol, non-HDL cholesterol, LDL cholesterol, apolipoprotein B, TG, HDL cholesterol, apolipoprotein A1, total cholesterol/HDL cholesterol, and apolipoprotein B/apolipoprotein A1 are all associated with increased risk of cardiovascular disease [10,11]. CVD is the major cause of morbidity with 2- to 4-fold increase in cardiovascular morbidity (coronary heart disease, stroke and peripheral vascular disease) in individuals with Type 2 Diabetes Mellitus (T2DM) compared to non-diabetic subjects and accounts for up to 80% of the mortality in T2DM [12]. The University Group Diabetes Program (UGDP) and the United Kingdom Prospective Diabetes Study (UKPDS), have found no relationship between glycemic control and diabetic macrovascular manifestations [13,14]. However, more recent clinical trials – the UKPDS 10 years follow-up study showed importance of glycemic control and its favorable influence on macrovascular outcome [15]. The STENO-2 study, a multifactorial intervention on cardiovascular risk factors, including an intensive control of lipids, glucose and blood pressure, reduces cardiovascular mortality [16]. Numerous studies consistently showed that pharmacological interventions that target the dyslipidemia and hypertension associated with T2DM, reduce risk of macrovascular complications in such patients [16,17]. Hence, we target conventional risk factors (e.g. smoking, hypertension, dyslipidemia etc) to improve the CVD related morbidity and mortality in diabetic subjects.

Prevalence of dyslipidemia in Indian diabetic subjects are much higher compared to general population and is present in about 85.5-97.8% of the uncontrolled diabetic patients on enrolment and 60.6% of controlled well-treated diabetes [18]. Combined dyslipidemia with high TG and low HDL or high LDL and low HDL are the most common

*Corresponding authors: Sanjay Chatterjee, Consultant Diabetologist, Apollo Gleneagles Hospital, Kolkata, India, Tel: 91-9831032310; E-mail: sanjay_doc@yahoo.co.in
Received August 27, 2014; Accepted September 24, 2014; Published September 26, 2014
Copyright: © 2014 Majumder A, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.
pattern of dyslipidemia and isolated low HDL level or isolated high TG are the second most common pattern of dyslipidemia among Indian diabetics [19].

**Beyond LDL-C: The non-HDL-C and TG**

Aggressive LDL-cholesterol lowering treatment has become the mainstay of lipid-lowering strategies for the last 2 decades. Despite achieving target LDL-cholesterol, statins reduce CVD risk by 25-35%. Despite the best evidence-based strategies, including high-dose statin therapy, it is clear that there persists an unacceptably high residual risk of cardiovascular events, especially in T2DM [20]. High TG and low HDL cholesterol levels have been shown to singly and collectively boost the risk of cardiovascular events independent of conventional risk factors [21]. Furthermore, guidelines recommend modifying high TG and low HDL as secondary therapeutic targets to provide additional vascular protection [14].

Given the high residual risk of cardiovascular events beyond effective LDL-lowering, identification of additional lipid biomarkers (HDL & TG) independently linked to vascular events, and the very limited effect of statins on modifying these lipid markers (HDL & TG), there is mounting interest in optimizing these additional lipid biomarkers via additional therapies. Addition of a fibrate, niacin, omega-3 fatty acids or a combination of statin with these agents is limited by uncertainties relating to the optimal level of PPARα-agonism, agonist-specific biologic responses, and the risk of adverse events specially with no increase of body weight [8].

**Omega-3 fatty acids**

Omega-3 fatty acids are effective in reducing diabetic dyslipidemia with relative free of side effects specially with no increase of body weight [8].

**Limitation of Current Pharmacologic-Therapeutic Strategies**

Multiple lipid lowering medications have been developed that effectively reduce TG with expectation to reduce the morbidity and mortality from CVD.

**Fibrates**

Fenofibrate (peroxisome proliferator-activated receptor-α [PPARα] agonist) and Fenofibrate Intervention and Event Lowering in Diabetes (FIELD) study, TG lowering therapy with fenofibrate did not significantly reduce the overall risk of the primary outcome of coronary events [22]. In a systematic meta-analysis of 18 trials with a total of 45,058 participants, the fibrates were found to reduce the risk of major cardiovascular events [23]. However, the magnitude of the effect is moderate and clinically meaningful reductions in risk was achieved only in high-risk individuals and specifically those with combined dyslipidemia. However, the efficacy of the current fibrates may be limited by uncertainties relating to the optimal level of PPARα-agonism, agonist-specific biologic responses, the side effects of current synthetic agonists and of course the relevance for patients already on statin therapy, specially in view of increased risk of muscle-related adverse events.

**Niacin**

Niacin (Extended-release [ER] niacin 1.5-2 g/day) showed the positive impact on HDL and TG values but did not demonstrate a beneficial effect on the primary endpoints (coronary heart disease death, nonfatal myocardial infarction, ischemic stroke, hospitalization for acute coronary syndrome, or symptom-driven coronary or cerebral revascularization) in patients with CVD and optimally treated with a statin but with residual atherogenic dyslipidemia in the AIM-HIGH (Atherothrombosis Intervention in Metabolic Syndrome With Low HDL/High Triglycerides: Impact on Global Health Outcomes) trial [24]. The much larger HPS2-THRIVE (Heart Protection Study 2-Treatment of HDL to Reduce the Incidence of Vascular Events) also failed to show a benefit on clinical outcomes with a different niacin formulation (combined with laropiprant) [25]. Moreover, treatment with niacin did adversely affect patients with higher risk of gastrointestinal events, musculoskeletal events, infection, skin-related adverse events, bleeding and new onset diabetes, leading to subsequent world-wide withdrawal of this therapy [26].

**Cholesteryl ester transfer protein inhibitors (CETP inhibitors)**

CETP inhibitors are effective in reducing CVD and concern about safety. Saroglitazar is a dual Peroxisome Proliferator-Activated Receptors-α/γ agonist, the first glitazar approved in the world and has emerged with a new hope to effectively reducing diabetic dyslipidemia with relative free of side effects specially with no increase of body weight [8].

**Saroglitazar Therapy**

Saroglitazar is currently the only agent of this class approved for the treatment of diabetic dyslipidemia in India (by Drug Controller General of India in June 2013) and the approval was based on the results obtained from clinical studies, which were conducted for more than eight years. Saroglitazar is a novel PPAR agonist with predominant PPARα and moderate PPARγ agonist activity. It is a non-thiazolidinedione and non-fibrate molecule and belongs to aryl alkoxy propionic acid class. Saroglitazar is well absorbed and has predictable pharmacokinetic parameters [34]. The elimination half-life of Saroglitazar is long and is supportive of once daily dosing. After oral administration, saroglitazar does not appear in urine samples, indicating that saroglitazar is not eliminated via the renal route and is mainly eliminated by the
enterohepatic route [34]. Saroglitazar is well tolerated up to a dose of 128 mg in the single-ascending dose study and this highest tested dose of 128 mg provide a safety margin of over 32-fold as the therapeutic dose is 2-4 mg per day [34]. Pharmacokinetics, safety and tolerability of Saroglitazar on a very limited number of healthy volunteers (n=5 or 6, as available) showed no serious adverse events and no clinically relevant trends or changes in laboratory values or ECG over time [34]. Only two serious adverse events were reported with 4 mg saroglitazar unrelated with the study drug. Pyrexia, dyspepsia and gastritis were the most common adverse events reported and were mild to moderate in intensity [35]. There were no significant changes in hemoglobin, liver enzymes, renal function, CPK, and high-sensitivity C-reactive protein with saroglitazar therapy for 12 weeks of treatment [34,35].

Saroglitazar (2 mg and 4 mg) therapy has shown 45% reduction in triglycerides and a significant reduction of other atherogenic lipids (LDL-C, VLDL-C, TC, Apo B) [8,35]. Saroglitazar showed a dose-related decrease in fasting glucose (mean 11.3 mg/dl reduction in 2mg arm and mean 22.6 mg/dl reduction in 4 mg arm) and HbA1c (mean 0.3% reduction in both 2 mg and 4 mg arm), very similar to Pioglitazone 45 mg therapy in a 24 week trial without any significant changes from baseline in any of the safety laboratory findings and importantly without significant change in bodyweights compared to pioglitazone (mean increase of body weight 1.6 kg) arm. The decrease in HbA1c level was comparable to pioglitazone (45 mg) and the reduction depended on the baseline value with higher the value, the greater the decrease [8]. Saroglitazar were evaluated in diabetic dyslipidemic patients insufficiently controlled with statin therapy and showed pronounced beneficial effect on both the lipid (significantly reduced mean plasma triglyceride levels by -45.5 ± 3.03% and -46.7 ± 3.02%, with 2-mg and 4-mg dose respectively, along with significant decrease in levels of non-HDL cholesterol, VLDL, total cholesterol) and glycaemic parameters [35]. In summary, Saroglitazar is the first drug having both lipid and glucose lowering effects ensuring a comprehensive management of diabetes and dyslipidemia.

Limitation of Saroglitazar

Saroglitazar is indicated as adjunctive therapy to diet and statin for treatment of adult diabetic patients with hypertriglyceridemia. Markedly elevated levels of TG (e.g., >500 mg/dl) even after glycerol control may increase the risk of developing pancreatitis. The effect of Saroglitazar therapy on reducing this risk has not been adequately studied.

The role of Glitazars in atherogenic dyslipidemia and diabetes has remained an area of interest for last two decades and appears suitable for diabetic patients on statin therapy who have residual cardiovascular risk. The development of most of these glitazars were complicated with safety issues leading to premature termination of many trials. Saroglitazar was shown to improve diabetic dyslipidemia but was not shown to reduce coronary heart disease in a large, randomized controlled trial of patients with T2DM.

Conclusion

Despite best evidence-based strategies and achievement of treatment goals for LDL cholesterol, blood pressure, and glycemia according to current standards of care, it is clear that there persists an unacceptably high residual risk of CVD events, especially in T2DM. It is advisable to stick to statins alone but residual risk should be addressed after optimization of LDL cholesterol. TG and HDL concentrations repeatedly shown to significantly predict future risk for cardiovascular disease and obviously considered important as therapeutic targets. However, pharmacological interventional trials with Fibrates or Niacin or Omega-3 fatty acids or CETP inhibitors, targeting TG and HDL repeatedly failed to show a benefit on CVD events and were complicated with safety issues leading to premature termination of many trials.

Saroglitazar is an approved therapy for diabetic dyslipidemia in India and it improves not only TG and HDL concentrations but also glycerol parameters. Although this review highlights clinical and experimental data that provide evidence for favorable effects of Saroglitazar on diabetic dyslipidemia, the lack of outcome studies limit our knowledge about their clinical cardiovascular efficacy and toxicity data may emerge with increasing use. Large multi-center longitudinal studies are required to demonstrate the safety & cardiovascular benefits of Saroglitazar and will clarify whether this dual PPAR agonist live up to their promise as vasculo-protective agent.

References


Submit your next manuscript and get advantages of OMICS Group submissions

Unique features:
• User friendly/feasible website-translation of your paper to 50 world's leading languages
• Audio Version of published paper
• Digital articles to share and explore

Special features:
• 350 Open Access Journals
• 30,000 editorial team
• 21 days rapid review process
• Quality and quick editorial, review and publication processing
• Indexing on PubMed (partial), Scopus, EBSCO, Index Copernicus and Google Scholar etc
• Sharing Option: Social Networking Enabled
• Authors, Reviewers and Editors rewarded with online Scientific Credits
• Better discount for your subsequent articles

Submit your manuscript at: https://omicsonline.info/editorialtracking/medicinechemistry/