PEROXISOME PROLIFERATOR ACTIVATED RECEPTOR-\(\alpha\) AGONIST AS A NOVEL THERAPEUTIC TO PREVENT OXIDATIVE STRESS AND ATRIAL FIBROSIS

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BACKGROUND

Atrial Fibrillation (AF), the most common heart rhythm disorder that predisposes stroke and heart failure is a major public health burden. Prevalence of AF associated with cardiac fibrosis and oxidative stress increases with aging. A common denominator for aging-related AF is excessive extracellular matrix deposition, yet, the molecular mechanisms regulating fibrosis are still obscure. Peroxisome proliferator-activated receptor-\(\alpha\) (PPAR\(\alpha\)), an important molecule for reactive oxygen species (ROS) and lipid degradation also involved in the development of cardiovascular disease. PPAR\(\alpha\) reported to negatively correlate with kidney, liver, and lungs fibrosis, but its role in cardiac fibrosis is less clear.

OBJECTIVE

We hypothesize that decreased expression of PPAR\(\alpha\) in AF contributes to oxidative stress and interfere with TGF-\(\beta\) signaling, a cytokine implicated in inflammation and cardiac fibrosis.

METHODS

Cell culture: Human atrial fibroblasts (hAF) isolated from AF and non AF patients right atrial appendages were grown in cardiac fibroblasts culture media. Cells were plated in media with or without 5ng/ml TGF-\(\beta\)1 in presence or absence of PPAR\(\alpha\) agonist cigroprolitate.

Transfection: hAF were transfected with mir-21 mimic or inhibitor using INTERFERIN (PolyPlus Inc.)

Histology of Atrial Appendage: Right atrial tissue pieces, washed in PBS, fixed overnight in 4% paraformaldehyde, and embedded in paraffin. 5-um sections were stained with Masson trichrome and fibrosis within sections as blue-stained areas was determined.

Immunohistochemistry: Immunostaining was performed on PFA fixed sections from atrial appendages and hAF for localization of a-SMA and Vimentin for determining the presence of myofibroblast (myofib). hAF treated with TGF for 72 hours were fixed, permeabilized and then treated with a-SMA antibody and anti-Vimentin, stained with Alexa Fluor 594 and 488-conjugated secondary and counterstained in Hoechst 33342.

Determination of 4-hydroxynonenal (4-HNE) protein adduct: Frozen atrial samples were homogenized and lysates were prepared. Supernatant obtained by centrifuging the lysates was used for measuring the levels of 4-HNE by ELISA using commercially available kit and superoxide production (MitoSOX Red) were assayed in patients’ atrial tissue homogenates and permeabilized cardiac myofibers respectively.

qRT-PCR: Total RNA was isolated by lysing the fibroblast in Qiagen and cDNA was synthesized. PCR was performed on A817300 or Light Cycler484 at 50°C for 2 minutes, 95°C for 10 min, 40 cycles of 95°C for 15 seconds, annealing for 1 min at 60°C then extension at 72°C for 40 seconds. Relative expression was assessed by normalizing CT values of the tested gene or miRNA with CT values of the housekeeping gene/miRNA.

Western blotting: Cell lysates were prepared in RIPA lysis buffer. Protein concentrations were determined and SDS-PAGE were run on NuPAGE NOVEX Bis-Tris 4-12%. Protein expressions were detected on the immunoblots with either Clarity (BioRAD) or Femto West Chemiluminescent Substrate Kit (Pierce).

RESULTS

![Graph showing the expression of PPAR\(\alpha\) in atrial fibroblasts of AF patients. Bar graph displays the mRNA expression (\(p=0.01\)) of PPAR\(\alpha\) between 0.5 and 7 days of age from right atrial appendages of non AF and AF patients. Data are presented as mean ± SEM, analyzed by t-test (two-tailed), \(n\) per group.](image)

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CONCLUSION

Reduced expression of PPAR\(\alpha\) in AF patients is associated with impaired cardiac mitochondrial metabolism and promotes TGF-\(\beta\)1 induced atrial fibrosis. Preliminary studies suggest PPAR\(\alpha\) agonist might offer therapeutic benefits for patients in reducing oxidative stress and cardiac fibrosis and therefore predisposition to AF.