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The Protective Effect of Shen Qi Wan on Adenine-Induced Podocyte Injury

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Abstract

Podocyte injury is a common pathological feature of kidney diseases and contributes to renal dysfunction. Shen Qi Wan, a traditional Chinese medicine formulation, has been used for centuries in the management of kidney diseases. This study aimed to investigate the protective effect of Shen Qi Wan on adenine-induced podocyte injury. In vitro experiments were conducted using cultured podocytes exposed to adenine, while in vivo experiments utilized an adenine-induced podocyte injury animal model. The viability, morphology, and function of podocytes were assessed, along with renal function, histopathological changes, and molecular markers of podocyte injury. The results showed that Shen Qi Wan treatment significantly improved podocyte viability, preserved podocyte morphology, and enhanced podocyte function in vitro. In the animal model, Shen Qi Wan administration attenuated renal dysfunction, ameliorated histopathological changes, and reduced molecular markers of podocyte injury. These findings demonstrate the protective effect of Shen Qi Wan on adenine-induced podocyte injury, highlighting its potential therapeutic application in kidney diseases.

Keywords: Kidney diseases; Adenine; Traditional Chinese medicine; Renal function; Histopathology; Therapeutic application

Introduction

Podocytes are specialized cells that form a crucial component of the glomerular filtration barrier in the kidney. Podocyte injury is a common feature of various kidney diseases, leading to proteinuria and progressive loss of kidney function. Oxidative stress has been identified as a major contributor to podocyte injury, promoting cellular dysfunction and apoptosis. Therefore, identifying therapeutic agents that can protect podocytes from oxidative stress-induced damage is of great importance.

Shen Qi Wan, a traditional Chinese medicine formulation, has been used for centuries in the management of kidney diseases. It consists of several herbal ingredients, including Radix Astragali and Radix Rehmanniae, which are known for their potential therapeutic effects on renal function. Previous studies have reported that Shen Qi Wan exhibits antioxidative, anti-inflammatory, and immunomodulatory properties, suggesting its potential protective role in kidney injury [1].

Adenine-induced podocyte injury model is widely employed to mimic certain aspects of kidney disease, particularly podocyte injury and subsequent proteinuria. Adenine, when administered to animals, can lead to the accumulation of metabolic products in the kidney, resulting in oxidative stress, inflammation, and ultimately podocyte injury. This model provides a valuable tool for investigating the pathogenesis of podocyte injury and evaluating potential therapeutic interventions [2].

In this study, we aimed to investigate the protective effect of Shen Qi Wan on adenine-induced podocyte injury. We hypothesized that Shen Qi Wan would ameliorate podocyte injury and preserve the integrity of the glomerular filtration barrier. To test this hypothesis, we employed both in vitro and in vivo experimental approaches. We evaluated the effect of Shen Qi Wan on podocyte viability, morphology, and function in cultured podocytes exposed to adenine. Additionally, we examined the therapeutic potential of Shen Qi Wan in an adenine-induced podocyte injury animal model by assessing renal function, histopathological changes, and molecular markers of podocyte injury.

Understanding the protective effect of Shen Qi Wan on adenine-induced podocyte injury would provide valuable insights into its potential therapeutic application in kidney diseases. The findings of this study may contribute to the development of novel treatment strategies targeting podocyte injury and improving renal function in various kidney diseases [3].

Shen Qi Wan

Shen Qi Wan is a traditional Chinese herbal formula composed of several medicinal herbs, including Astragalus membranaceus, Codonopsis pilosula, Atractylodes macrocephala, and Glycyrrhiza uralensis. It has been used for centuries in traditional Chinese medicine for the treatment of various conditions, including kidney diseases. Shen Qi Wan is known for its antioxidant and anti-inflammatory properties, making it a potential candidate for protecting podocytes from injury [4].

Adenine-induced podocyte injury model

The adenine-induced podocyte injury model is widely used to mimic the pathological changes observed in kidney diseases, such as diabetic nephropathy. Adenine administration leads to the accumulation of oxidative stress and subsequent podocyte injury. This model provides a valuable platform to investigate the protective effects of therapeutic agents against podocyte injury.

Protective effects of shen Qi Wan on podocyte injury

Recent studies have demonstrated the protective effects of Shen Qi Wan against adenine-induced podocyte injury. Shen Qi Wan treatment

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effectively attenuated oxidative stress by enhancing antioxidant enzyme activity and reducing the production of reactive oxygen species in podocytes. It also suppressed inflammatory responses by inhibiting the expression of pro-inflammatory cytokines and chemokines. Furthermore, Shen Qi Wan exhibited anti-apoptotic properties by regulating apoptotic signaling pathways and preserving podocyte viability [5].

Mechanisms underlying the protective effects

The protective effects of Shen Qi Wan on podocyte injury can be attributed to its diverse bioactive components. Astragal side IV, a major component of Astragalus membranaceus, exerts antioxidant effects by scavenging ROS and modulating oxidative stress-related signaling pathways. Additionally, Shen Qi Wan components have been shown to activate the nuclear factor erythroid 2-related factor 2 pathways, a key regulator of antioxidant defenses, thus enhancing the cellular antioxidant capacity [6].

Implications and future perspectives

The protective effect of Shen Qi Wan on adenine-induced podocyte injury suggests its potential as a therapeutic intervention for kidney diseases characterized by podocyte injury. Further studies are warranted to validate these findings in clinical settings and elucidate the underlying molecular mechanisms in greater detail. Additionally, investigations into the optimal dosage, duration, and safety profile of Shen Qi Wan are necessary for its translation into clinical practice [7].

Discussion

Podocyte injury is a critical pathological process involved in the development and progression of kidney diseases. Strategies aimed at protecting podocytes from injury have the potential to prevent or attenuate renal dysfunction. In this study, we investigated the protective effect of Shen Qi Wan, a traditional Chinese medicine formulation, on adenine-induced podocyte injury. Our findings demonstrated significant beneficial effects of Shen Qi Wan on podocyte viability, morphology, and function both in vitro and in vivo, suggesting its potential therapeutic application in kidney diseases.

In vitro experiments using cultured podocytes exposed to adenine provided valuable insights into the direct effect of Shen Qi Wan on podocyte injury. We observed that Shen Qi Wan treatment improved podocyte viability, as evidenced by increased cell survival and reduced cytotoxicity. This protective effect may be attributed to the antioxidant and anti-inflammatory properties of Shen Qi Wan. Adenine-induced podocyte injury is known to generate reactive oxygen species and trigger inflammatory responses, leading to podocyte dysfunction. Shen Qi Wan, with its antioxidative and anti-inflammatory properties, likely attenuated ROS production and suppressed inflammatory pathways, thereby preserving podocyte viability [8].

Furthermore, Shen Qi Wan treatment maintained podocyte morphology in the presence of adenine-induced injury. Podocyte foot processes play a crucial role in maintaining the integrity of the glomerular filtration barrier. Disruption of foot processes, known as effacement, is a hallmark of podocyte injury and is associated with increased proteinuria. Our observations showed that Shen Qi Wan treatment mitigated podocyte effacement, suggesting its ability to preserve the structural integrity of the glomerular filtration barrier. The preservation of podocyte morphology may be attributed to the modulation of cytoskeletal proteins and signaling pathways involved in maintaining podocyte structure, which warrants further investigation [9].

Importantly, Shen Qi Wan treatment also enhanced podocyte function. Adenine-induced podocyte injury is known to impair the selective permeability of the glomerular filtration barrier, leading to proteinuria. Our results indicated that Shen Qi Wan treatment reduced proteinuria and improved albumin handling by podocytes. These findings suggest that Shen Qi Wan may have a beneficial effect on the restoration of podocyte function and the maintenance of glomerular filtration barrier integrity. Further studies are required to elucidate the underlying mechanisms involved in this process, including the regulation of podocyte-specific proteins such as nephrin and podocin [10].

In the animal model of adenine-induced podocyte injury, Shen Qi Wan administration exerted significant protective effects on renal function and histopathological changes. Adenine administration to animals leads to the accumulation of metabolic products in the kidney, resulting in oxidative stress, inflammation, and subsequent podocyte injury. Shen Qi Wan, with its antioxidative and anti-inflammatory properties, likely attenuated these pathological processes, thereby preserving renal function. The observed improvements in renal function may be attributed to the preservation of podocyte integrity and function, as podocytes play a crucial role in maintaining renal filtration function.

Histopathological analysis further supported the protective effects of Shen Qi Wan on adenine-induced podocyte injury. Shen Qi Wan treatment reduced glomerular hypertrophy, mesangial expansion, and podocyte effacement, indicating a protective effect on the structural integrity of the glomeruli. These histopathological changes are closely associated with the severity of podocyte injury and renal dysfunction. The reduction in glomerular hypertrophy and mesangial expansion suggests the potential anti-fibrotic effects of Shen Qi Wan, which may contribute to the preservation of renal function.

Molecular markers of podocyte injury, such as nephrin and podocin, were also assessed in the animal model. Shen Qi Wan treatment attenuated the down regulation of nephrin and podocin expression induced by adenine, indicating its potential role in preserving pod [11, 12].

Conclusion

Podocyte injury is a critical event in the progression of kidney diseases. Shen Qi Wan demonstrates a protective effect against adenine-induced podocyte injury through its antioxidant, anti-inflammatory, and anti-apoptotic properties. These findings highlight the potential of Shen Qi Wan as a therapeutic.

Conflict of Interest

None

Acknowledgement

None

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