Targeted Treatment of Common Human Diseases With Glutathione

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Abstract. Glutathione (GSH) is a typical medication and health product. Previous research has shown that GSH, which has substantial antioxidant activity, is involved in a number of crucial intracellular metabolic activities. By decreasing oxidative stress, disorders like tumors, alcoholic liver disease, and IRI can be somewhat improved. This research will examine the clinical management of heart, ocular, liver and skin illnesses, with GSH serving as the narrative focus. The association between coronary heart disease and oxidative stress was revealed by the fluorescence detection of GSH and OPA, and the amelioration of some coronary atherosclerosis by GSH was suggested. Additionally, GSH can successfully prevent surgical damage brought on by valve surgery and I/R and preserve the cardiac muscle during the procedure. For people with early cataracts, GSH eye drops are crucial, and they are more effective than oral vitamins and smoke tablets. GSH has been shown to significantly minimize problems in early and middle stage individuals with chronic hepatitis B. GSH is fairly developed in terms of skin conditions and aesthetics. Melasma can be reduced, whitened, and controlled through intravenous injection and oral means.

Keywords: Glutathione; Human health; Targeted treatment.

1. Introduction

Glutathione (GSH) is a low molecular tripeptide with the most sulfhydryl groups in the human body. It is made up of glutamic acid, glycine, and cysteine. With a 9:1 distribution, it is primarily found in the cytoplasm and mitochondria, with a minor portion also present in the endoplasmic reticulum [1]. GSH occurs as either GSH or oxidized glutathione (GSSG), with the former accounting for over 98% of total glutathione content [2]. The majority of GSH has a ratio of at least 10:1 to GSSH, which is partially critical for the dithiogroup's enzyme activity [3]. Cysteine can be transported via the gamma-glutathione cycle by GSH, which also has active sulfhydryl groups and gamma-glutamyl linkages. The REDOX of glutathione and hydrogen peroxide is directly mediated by glutathione reductase (GSR) and glutathione peroxidase (GPx), the primary enzyme of free radicals [2]. The steady condition of intracellular markers is strongly impacted by this cyclical process. GSH is also involved in numerous physiological processes in the cell, including metabolism, synthesis, antioxidant defense, and detoxification [1].

The outstanding antioxidant properties of GSH, which are frequently emphasized, are due to its capacity to bind to free radicals which produced by NADPH equilibrium system and peroxides. Its antioxidant defense system utilizes an enzyme system with potent oxidizing and hygroscopic properties to remove any remaining free radicals and reactive oxygen species that could harm cells and tissues [3]. This safeguards sulfhydryl groups and water stored in cells from oxidative attack and stops free radicals from harming vital organs [3]. In addition, normal hemoglobin and appropriate oxygen supply capability are guaranteed by the REDOX balance of GSH to prevent methemoglobin synthesis [2]. GSH can significantly lessen medication toxicity based on the non-toxic molecules produced by S-transferase and exogenous substances [2]. To fulfill the goal of human body detoxification, its sulfhydryl group and electrophilic metabolites cause an enzymatic binding reaction to make thioetheric acid and remove in vitro [1]. It has been discovered that this mechanism has a favorable relationship with anti-cancer drug resistance, which can further encourage oxidative stress on the basis of tumor chemotherapeutic treatments.

The consumption of GSH and oxidative stress both have a direct impact on disorders connected to the heart, kidneys, cancer, and other significant lesions. GSH can detect both cell activity and high sensitivity. As a result, the primary goal of research is to ameliorate the oxidation imbalance of GSH in various treatment programs. In previous studies, participants with alcoholic liver disease who were treated with intravenous glucose with a dose of GSH, and indicators of liver function returned to normal, while hepatocyte fat, which can cause lesions and fibrosis, was interrupted. Injections of GSH 24 hours before and after can successfully lessen the relationship between oxidative stress and inflammation [4]. Reduce the severity of the clinical condition known as acute renal ischemia reperfusion damage (IRI), which is brought on by both endogenous and external renal injury, and to some extent protect the kidney [4]. Additionally, GSH's antioxidant properties have advanced significantly in numerous studies on targeted drug therapy that can enhance tumor resistance, such as those involving GSH synthesis inhibitors, degradation inhibitors and inhibitors, which have drawn significant interest and been carried out in a systematic manner in clinical trials. The relationship between GSH and human health, including some common diseases as well as clinical drug development, will be the main topics of this research.

2. Application of GSH in Disease Treatment

2.1. Coronary Heart Disease

Coronary atherosclerosis (AS), on which coronary heart disease is founded, has gradually become more common in recent years. One of the most significant and serious subtypes of coronary heart disease is acute myocardial infarction (AMI). The severity of AS, a common cause of which is oxidative stress, is closely correlated. The plasma samples of the early CHD group, the CHD group, and the normal control group exhibited a steady decline of GSH as the value of GSSH increased in the investigation of the fluorescence detection method employing GSH and OPA to generate indole [5]. As a result of the higher REDOX potential and the markedly altered GSH/GSSH ratio, the macroscopic REDOX is continually tipped toward the oxidation state [5]. As a result, the proper REDOX and metabolic stability of the modified myocardenum are favorably linked with the elevation of GSH.

In addition, GSH is utilized to prevent oxidative damage to myocardial function before surgery and to control cardiac tissue injury following surgery. Before replacing a heart valve, individuals with heart valve dysfunction must have their venous blood oxygenated by an artificial heart-lung machine [6]. This procedure creates oxygen free radicals and oxidative stress, which might cause myocardial problems [6]. For example, 150 patients in all were evenly split between the control and observation groups over the course of the two-year trial. As Table 1 showed, at various stages of aortic opening, the three postoperative indicators of myocardial damage, inflammatory factor levels, and pulmonary ventilation performance in the observation group that received a 1200 mg GSH injection were considerably lower than those in the control group [6]. Consuming the potent antioxidant GSH will successfully achieve the impact of scavenging free radicals.

However, endogenous antioxidant activity was raised and I/R effect was reduced in rat models receiving GSH supplement paired with regular exercise, according to a study on the treatment of cardiac ischemia reperfusion injury (I/R) with GSH [7]. The administration of GSH solution before thrombolysis in AMI patients can effectively inhibit the activity of oxygen free radicals and lipid peroxidation, as well as slow down the release of myocardial enzymes, according to a study to investigate the universality of GSH dilution of I/R oxidative injury in the human body [8]. When the myocardial is recanalized following coronary artery blockage, sequelae and physiological unfavorable reactions can be avoided because the myocardium's homeostasis and REDOX status are in normal coordination. By boosting the sample size, we will eventually investigate the scope and efficiency of GSH in somewhat reducing myocardial damage [6].

Table 1. Comparison of myocardial injury, inflammatory factor levels and pulmonary ventilation function indexes between the two groups [6].

Index type		Test population	T0	T1	T2	T3
myocardial injury index	LDH (IU/L)	observation group	130.19±18.65	534.10±50.38	358.17±60.24	279.64±41.08
		control group	135.37±17.39	579.39±51.62	416.25±61.05	352.29±50.27
	CK-MB (U/L)	observation group	9.12±1.36	36.57±6.19	34.25±6.37	32.14±6.19
		control group	8.89±1.42	51.95±9.27	42.94±9.06	40.31±8.04
	cTnI (μg)	observation group	0.05±0.03	1.38±0.23	2.24±0.35	1.87±0.21
		control group	0.06±0.04	1.79±0.31	4.39±0.39	3.52±0.37
Inflammatory factor levels	IL- (pg/mL)	observation group	33.95±5.42	133.16±21.07	120.87±21.64	105.37±20.33
		control group	33.11±5.36	152.34±22.39	133.52±22.19	120.59±21.38
	hs-CRP(mg/L)	observation group	2.16±0.41	11.31±2.05	9.12±1.85	6.06±1.20
		control group	2.09±0.38	14.69±2.74	10.98±2.07	7.59±1.47
Pulmonary ventilation function indexe	OI (mmHg)	observation group	402.61±31.59	289.54±28.26	328.15±23.75	365.28±28.97
		control group	405.14±30.62	275.39±59.04	316.92±24.16	341.50±26.34
	A-aDO_2 (mmHg)	observation group	117.69±12.61	131.59±13.28	143.68±20.24	133.49±25.19
		control group	119.04±11.35	137.64±14.05	168.15±22.71	151.17±25.34

2.2. Age-Related Cataract

A somewhat frequent eye illness that causes blindness is cataract. The lens is opaque because of improper light dispersion and a protein crystallization phase that is not uniform due to a damaged lens microstructure. However, age-related cataract (ARC), which has a very complicated multi-factor etiology, is most prevalent in the older population. Including, but not limited to, a range of environmental elements like ultraviolet light and human endocrine diseases, long-term sustained damage to the lens that results in denaturation of crystal proteins and turbidity of the lens. Following a comparison between the lenses cortical mass of early stage patients and those of stage III patients, GSH fell by almost 34.6% in a study of 101 ARC patients with an average age of around 72 years [10]. Because the aging lenses lower GSH content and associated multi-functional isoenzyme GSTs activity prevent them from carrying out normal catalytic and metabolic activities, so reactive oxygen species produced by peroxidation damage are also a significant contributing factor to ARC [9].

As the primary component of the lens, GSH has the same action as ascorbic acid and can prevent susaturation of the mercaptan oxidation of the lens protein while maintaining normal permeability of the lens epithelium [10]. Glutathione eye drops are therefore beneficial in the clinical therapy of cataract, especially for early patients [11]. Even while the impact is not as quick, the safety and controllability of GSH are unquestionably more noticeable when compared to the extensively practiced current minimally invasive phacoemulsification cataract surgery [11]. The visual acuity and iop of the observation group were dramatically improved compared to the control group with a one-year adjuvant treatment with oral vitamins, Fuming tablets, and GSH eye drops, and the crystal

transparency could be successfully recovered [11]. Patients treated with GSH eye drops paired with vitamins were 22.9% more successful than those given with the same action drug, Baineidin eye drops combined with vitamins, in another group of comparable investigations [12]. Additionally, it is less expensive and has less side effects, thus it is anticipated that it will receive aggressive promotion in the treatment of cataracts [12].

2.3. Chronic Hepatitis B

When the chronic hepatitis B virus (HBV) is detected, it causes the relatively serious liver condition known as chronic hepatitis B (CHB). It is contagious, possesses an unclear mode of action, and, over time, may progress to cirrhosis and hepatocellular carcinoma (HCC). The hepatitis B virus X gene (HBVX) in mitochondria plays a crucial role in the development of cell malignancy and HBV infection [13]. There was no discernible difference between mild patients and healthy controls in the analysis of HBVX expression in peripheral blood mononuclear cells (PBMC) of chronic hepatitis B patients at various stages of the disease using RT-PCR detection. The levels of ROS and MDA considerably rose as the stage disease deteriorated. As a result, by decreasing mitochondrial permeability and metabolic capability, HBVX can lead to an imbalance in oxidation and a significant number of free radicals [13].

By integrating both antioxidant and anti-fiber medications at the early stage, the disease can be effectively postponed and some liver damage can be mitigated, using oxidative stress as a breakthrough point [14]. Both the control group receiving Entecavir alone and the antiviral treatment with GSH and Entecavir demonstrated a reduction in serum liver fibrosis indexes, but the former was more pronounced [14]. Patients receiving GSH demonstrated a significant improvement in liver function indicators, suppression of liver fibrosis, and a decrease in the number of liver cell deaths in another comparable double-blind study of GSH adjuvant therapy for mild to moderate injury and chronic hepatitis B without obvious cirrhosis [15].

The process of curing the liver is aided by GSH's antioxidant and liver-protective properties. As a result, even though other clinical treatment plans and GSH assistive technology cannot completely cure the disease, they can significantly improve the physical and mental health of patients with CHB by inhibiting the virus and lowering the likelihood of complications down the road.

2.4. Skin Aspect

GSH can lighten and heal the skin to some extent and is used to treat some common skin conditions. As shown in Table 2, the subjects who consumed the fruit drink demonstrated an increasing trend in skin whiteness and a declining melanin index on the whitening impact of collagen complex fruit drink combined with GSH and niacinamide [16].

Table 2. Statistical results of skin melanin index
MI value and skin color index *L value (n=76) [16].

Test population	Deta type	Before	After 2 weeks	After 4 weeks
Control group	MI	180	178	181
	*L	60.11	60.10	60.14
Test group	MI	179	171	164
	*L	60.05	60.08	61.08

The individuals who consumed the samples performed normally on the three standard hematuria and stool tests without experiencing any pain [16]. As can be seen, GSH efficiently inhibits the body's creation of melanin by acting as a powerful antioxidant and preventing the formation of free radicals. When combined with niacinamide and collagen, GSH also produces a more pronounced whitening effect.

Additionally, GSH is involved in melasma, a prevalent skin condition in women brought on by an overabundance of melanin. According to research by Lin Chunsheng, GSH activity can effectively control melasma by preventing endocrine and hormone abnormalities, regulate certain hormone

levels, and boost metabolism while maintaining the balance of metabolic response [17]. The ratio of participants who recovered to the total number of participants improved by 25 percentage points when intravenous GSH and oral vitamin C supplements were combined. Further, the dual treatment group had more noticeable improvement in the stain's location and color. GSH is also more important than other medications in the treatment of melasma patients, and its efficacy rate is greater than 1.67 times that of snow glycoside ointment [18]. However, the combined usage of the two had an effective rate of up to 88.37%, and only a small number of patients experienced uncomfortable local skin irritation [18].

3. Conclusion

GSH has a certain protective impact on the body when combined with the aforementioned. Additionally, GSH has a more pronounced and positive therapeutic effect on patients in the early and middle stages of illness and is currently frequently used in diseases with unclear origin but with oxidative stress. GSH has a clinical track record of having a nearly flawless function in the healing and repair of skin. Future clinical trials and larger sample sizes are anticipated to enable GSH to serve as a multifunctional medication.

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