The present study was aimed to evaluate the beneficial effect of Cystone syrup in an experimental model of glycerol-induced acute renal failure (ARF) in rats. Biochemical parameters, kidney weight and histopathological evaluation were performed to conclude the beneficial effect of Cystone syrup. Administration of single dose of 50% v/v glycerol (8ml/kg.i.m) caused severe renal dysfunction associated with significant increase in markers of renal function such as serum urea ($p<0.01$), creatinine ($p<0.01$), blood urea nitrogen (BUN) ($p<0.01$), decrease in the Creatinine clearance (Ccr) ($p<0.01$) and increase in kidney weight to body weight ratio ($p<0.01$) compared to control group. These changes were in accordance with the histopathological findings showing severe tubular necrosis, degeneration and moderate luminal cast formation. In contrast, pre-treatment with Cystone (5 ml/kg, p.o) for seven days, alleviated the glycerol induced renal dysfunction significantly by maintaining serum urea ($p<0.01$), creatinine ($p<0.05$), BUN ($p<0.01$) and kidney weight to body weight ratio ($p<0.05$) near to normal range, also improved the creatinine clearance ($p<0.05$) compared to untreated positive control. In addition, histopathology of Cystone (5 ml/kg, p.o) treated group showed mild to moderate tubular necrosis and degeneration. Thus, the findings of the present study demonstrates the usefulness of Cystone syrup in reversing the biochemical/ structural markers of renal dysfunction observed in experimental model of renal failure in rats.

Keywords: Acute renal failure, Cystone, Glycerol intoxication, Creatinine clearance
myoglobin ARF shows many hall marks of the crush syndrome, the archetypical form of human ARF [8,9].

Cystone, a well-known polyherbal formulation is based on ancient Ayurvedic system of medicine, and has been used for many years to treat urinary calculi and UTI. Previously it has been proved that, cystone is very effective in preventing the supersaturation of lithogenic substances and additionally it possesses antioxidant activity [10,11]. In this context, we investigated the beneficial effect of cystone on renal dysfunction in an experimental model of glycerol-induced ARF in rats.

**MATERIALS AND METHODS**

**Animals**

Inbred male wistar rats (225-250g) were used in this study. Animals were housed in standard isolation cages under environmental conditions of temperature (22 ± 2°C), relative humidity (60 ± 5%) and light (12 h light/dark cycles). Rats were allowed free access to water and standard laboratory rat chow (Provimi India, Bangalore) ad libitum. The protocol was approved by Institutional Animal Ethics Committee (IAEC) of The Himalaya Drug Company, Bangalore, and all the experiments on animals carried out as per the CPCSEA guidelines.

**Drugs and Chemicals**

Glycerol (Loba Chemie Pvt. Ltd., India), Cystone Syrup (The Himalaya Drug Company, Bangalore), all the biochemical kits were purchased from Erba Diagnostics, Mannheim, Germany. All the other chemicals and reagents were of analytical grade and purchased from HiMedia Laborateries Pvt Limited., India.

Five millilitres of cystone syrup contains extracts of the following medicinal plants in definite proportions: Gokshura (*Tribulus terrestris*) 91 mg; punarnava (*Boerhaavia diffusa*) 67 mg; Pashanabheda (*Saxifraga ligulata*) 53 mg; Mustaka (*Cyperus rotundus*) 42 mg; Satavari (*Asparagus racemosus*) 21 mg; Kulattha (*Dolichos biflorus*) 21 mg; Ushira (*Vetiveria zizanioides*) 21 mg and Karchura (*Curcuma zedoaria*) 14 mg.

**Experimental protocol**

Forty male wistar rats were divided into four groups (G-I to G-IV, n=10). Rats from Group I and II received DM water (10ml/kg.p.o) and served as normal and positive untreated control respectively. Rats from Group III and IV received Cystone syrup at the dose of 2.5 and 5 ml/kg body weight / day, p.o. respectively. After one week of the assigned treatment, all the animals (G-II to G-IV) except G-I received a single intramuscular injection of glycerol (50% v/v) 8 ml/kg body weight, in divided dose to both the hind limbs; animals of G-I were injected with normal saline 8 ml/kg IM. 24-hours after the injection, urine samples were collected and after 48 hrs all the animals were bled to death under deep ether anaesthesia, blood and kidneys were collected for biochemical and histopathological examinations respectively.

Serum creatinine, urea were evaluated by Erba diagnostic kit. BUN and creatinine clearance were calculated using the equation given below.

\[
\text{BUN} = \frac{\text{serum urea (mg/dL)}}{2.14}
\]

\[
\text{Creatinine clearance rate} = \frac{\text{Urine Creatinine (mg/l)} \times \text{Urine output (ml)}}{\text{Serum Creatinine (mg/l) \times 1440 (min)}}
\]
Renal histopathology

The kidneys were isolated immediately after sacrificing the animal, washed with ice cold saline and fixed in 10% neutral buffered formalin solution and processed for histopathological evaluation.

Statistical analysis

The results were expressed as mean ± SEM and analyzed statistically by One Way ANOVA followed by Tukey’s multiple comparison test using Graph pad Prism software package (Version 4.0). The minimum level of significance was fixed at <0.05.

RESULTS

Effect of Cystone on glycerol-induced renal dysfunction

Intramuscular injection of 8 ml/kg of hypertonic glycerol produced a marked derangement in the renal function and lead to a significant increase in the level of serum urea, creatinine, BUN and a severe fall in the clearance values of creatinine. Also, there was significant increase in kidney to body weight ratio. Pre-treatment with Cystone (5 ml/kg, p.o.) produced significant improvement in the renal functions by maintaining the all biochemical parameters and kidney to body weight ratio near to control group (Fig. 1-5).

Effect of Cystone on glycerol-induced changes on renal morphology

The renal morphology of control group animals was found to be normal (Fig. 6). In contrast, the kidneys of rats treated with glycerol showed marked histological changes in the cortex and outer medulla. The renal sections showed severe tubular necrosis, degeneration and moderate luminal cast formation (Fig. 7). Treatment with Cystone (2.5 ml/kg, p.o) did not show any significant morphological protection. However, Cystone
It was reported that Cystone could alleviate oxidative stress by scavenging free radicals and reducing lipid peroxidation by enhancing antioxidant defence mechanisms [11,20].

In conclusion, Cystone, a polyherbal preparation used clinically for many years for urinary complications, has been shown to provide partial but significant protection against renal damage - induced by the glycerol intoxication. The anti-oxidant property of cystone could be one of the mechanisms behind the beneficial effect observed in the present study.

CONFLICTS OF INTEREST

Author declares that there are no conflicts of interest.

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