Cystone, a well-known herbal formulation improves renal function in rats with acute renal failure (ARF) induced by Glycerol intoxication

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ABSTRACT

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

Acute renal failure (ARF) is frequent in hospitalized critically ill patients and mortality associated with ARF is largely unchanged over many decades. ARF is mainly characterized by acute tubular necrosis. Progress in elucidation of ARF pathophysiology has led to the development and testing of many therapeutic drugs and other interventions in animal and human forms of acute tubular necrosis [1,2]. Renal replacement therapy has promising features in treating of ARF, especially before complications. However, it was reported that the incidence of ARF has been constantly rising over the past two decades [3,4] and mortality rate exceeded 50% among those who required dialysis support [5,6].

Furthermore, mortality rates have changed little over the past few decades despite significant advances in supportive care. In addition, prevention of the occurrence and progression of ARF has become a very important issue. In recent years, great efforts have been focused on traditional and herbal medicine to provide a safe and therapeutically potential agent for ARF [4,6].

Glycerol is used for the induction of ARF in-vivo; intramuscular administration of hypertonic glycerol is the most commonly used animal model of myoglobinuric ARF [7]. It is reported that the acute volume depletion model of glycerol induced ARF is more closely related to the syndrome of ARF in human
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beings, than the chronic dehydration model. Glycerol
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 Laboratories 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; Pashanabhedaka (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.

\[
\text{BUN} = \frac{\text{serum urea (mg/dl)}}{2.14} \\
\text{Creatinine clearance rate} = \frac{\text{Urine Creatinine (mg/l)} \times \text{Urine output (ml)}}{\text{Serum Creatinine (mg/l)} \times \text{1440 (min)}}
\]
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 \( p<0.05 \).

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
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(5 ml/kg, p.o) treated group showed very mild tubular necrosis and degeneration (Fig.8) and hence found to promising in preventing the glycerol-induced renal damage.

DISCUSSION

ARF is characterized by rapid decline in glomerular filtration rate and retention of nitrogenous waste products. Skeletal muscle accounts to about 40% of the body weight, and when massive necrosis occurs following injury it is termed as rhabdomyolysis [12,13]. Number of studies have shown that rhabdomyolysis - induced myoglobinuric ARF accounts for about 10-40% of all cases of ARF [14].

The intramuscular administration of hypertonic glycerol induces myolysis and hemolysis and affords a faithful and widely utilized model of heme protein-induced renal injury [15,16]. Myoglobinuric ARF has three pathogenic mechanisms: tubular obstruction, renal vasoconstriction and oxidative stress [17]. The latter is generated through the iron released from the heme group of the myoglobin. Iron induces the formation of high-activity oxygen free radicals that increase oxidative stress and provoke lipid peroxidation and cellular death [18,19].

In the present study, 48 h after glycerol administration the levels of serum urea, creatinine and BUN were significantly increased. Our findings are in consistent with previous reports [14]. These results indicated that renal function was severely impaired in ARF rats. However, pre-treatment with Cystone prevented the elevation of serum urea, creatinine and BUN. Furthermore, pre-treatment with Cystone prevented the renal morphological changes caused due to administration of glycerol. These results suggested that Cystone plays an important role as a renoprotective agent against ARF. 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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