

Article

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Nephroprotective effect of *Aloe barbadensis* Miller against gentamicin induced nephrotoxicity in long evans male rats

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Abstract

Background: Kidney is an essential excretory organ of our body. It can be damaged by poisonous effect of chemicals, toxin, prolonged and uncontrolled use of drugs. Aloe vera is a herbal plant, it can be used for the prevention and treatment of kidney damage due to its natural compatibility. **Objective:** To observe the nephroprotective effect of Aloe vera against gentamicin induced nephrotoxicity in long evans male rats. **Method:** This experimental study was conducted in the Department of Physiology, Sir Salimullah Medical College (SSMC), Dhaka from 1st January 2018 to 30th December 2018. For this, forty five (45) apparently healthy long evans male rats, 90-120 days old, weighing between 150-200 g were taken and divided into control group (group A) and experimental group (group B - Aloe vera pretreated and gentamicin treated group). Control group was subdivided into group A₁ (baseline control group) and group A₂ (gentamicin treated control group). Each group consisted of fifteen (15) rats. At the beginning of the study period initial body weight of rats were measured at day 01. All the rats received basal diet for thirty (30) days. Group A₁ received only basal diet for 30 consecutive days (started from day 1 to day 30). In addition to basal diet, group A₂ received injection gentamicin intraperitoneally once daily in the morning (80 mg/kg/day) for last 5 days (26th to 30th) of the study period. Again, in addition to basal diet, experimental group received Aloe vera orally (200 mg/kg/day) for 30 days and injection gentamicin

intraperitoneally (80 mg/kg/day) for last 5 days (26th to 30th). After measuring final body weight all the rats were sacrificed on day 31. Blood sample was collected from heart. Serum levels of creatinine and urea were estimated for assessment of kidney function. Statistical analysis was done by one way ANOVA test followed by post hoc-Bonferroni test. **Result:** Mean serum levels of creatinine and urea were significantly ($p < 0.001$) higher in gentamicin treated control group in comparison to that of base line control group. Again these levels were significantly ($p < 0.001$) lower in Aloe vera pretreated and gentamicin treated group than that of gentamicin treated control group. **Conclusion:** From this study, it is concluded that Aloe vera has nephroprotective effect against gentamicin induced nephrotoxicity.

Key words: Aloe vera, Nephroprotective, Gentamicin.

Introduction

Gentamicin is an aminoglycoside widely used in the clinical practice for the treatment of both gram-negative and gram-positive bacterial infections. It is used in the treatment of septicemia, sepsis, bacterial endocarditis, etc. Its main side effects are ototoxicity, neuromuscular blockade and toxic renal damage¹. So, nephrotoxicity is one of the common side effect for patient receiving gentamicin².

Now a days, different herbal plant products show good prospect to overcome such unwanted side effects. Several experimental studies with plant products such as *Nigella sativa*³, curcumin⁴, honey⁵, gum Arabic⁶ have used for preventing and treating gentamicin induced nephrotoxicity.

Aloe vera (*Aloe barbadensis* Miller) is a herbal plant which is cheap, easily available and safe. It has several biologically active substances such as polyphenols, indoles and alkaloids⁷. This herb has various medicinal properties such as anti-inflammatory⁸, antidiabetic⁹, antioxidant¹⁰, and hepatoprotective effects¹¹.

Again, this medicinal plant extract was shown to decrease serum urea and creatinine levels in rat models of gentamicin induced nephrotoxicity¹². Moreover serum urea and creatinine levels were found significantly lower in gentamicin induced nephrotoxic rats with 7 days Aloe vera treatment in comparison to those of without Aloe vera treated rats¹³.

However, as far as it has been searched, no reported data regarding prevention of gentamicin induced nephrotoxicity by Aloe vera was available in our country. On the basis of this background, this study has been designed to evaluate the nephroprotective role of Aloe vera against gentamicin induced nephrotoxicity in long evans male rats.

Methods

This experimental study was conducted from 1st January to 30th December 2018 in the Department of Physiology, Sir Salimullah Medical College, Dhaka. Ethical permission was taken before conducting the study from Institutional Ethics Committee (IEC) of Sir Salimullah Medical College (SSMC), Dhaka.

Procurement and maintenance: A total number of forty five (45) apparently healthy long evans male rats, 90-120 days old, weighing between 150-200 g were purchased from animal house of Department of Pharmacology, BSMMU and the rats were kept in the animal house of Institute of Nutrition and Food Science, University of Dhaka. All the rats were acclimatized for 14 days prior to intervention at 23 ± 2 °C room temperature under 12 hours dark–light cycle. During this period, the animals had free access to food and water ad libitum. At the beginning of the study period (day-1) initial body weight of rats were measured.

Grouping and dose schedule

All the rats were divided into two groups, control group (group A) and experimental group (group B - Aloe vera pretreated and gentamicin treated group). Control group is subdivided into group A₁ (baseline control group) and group A₂ (gentamicin treated control group). Each group consisted of fifteen (15) rats. All the rats received basal diet for thirty (30) days. Group A₁ received only basal diet for 30 consecutive days (started from day 1 to day 30).

In addition to basal diet, group A₂ received injection gentamicin intraperitoneally once daily in the morning (80 mg/kg/day) for last 5 days (26th to 30th) of the study period. Again, in addition to basal diet experimental group received Aloe vera orally (200 mg/kg/day) for 30 days and injection gentamicin intraperitoneally (80 mg/kg/day) for last 5 days (26th to 30th).

*Preparation of ethanolic extract of Aloe vera:*¹⁴

Aloe vera leaves washed with water, then parenchymatous covering of the leaves were peeled and gel drained out. Then the gel was dried in an air-oven. The dried sample was crushed

into powder with an electrical grinder. Then ethanolic extract of aloe vera gel extract was prepared. The concentrated extract was dissolved in distilled water for administration to rats.

Blood collection: On the day 31, at the end of the study period, after measuring the final body weight, all the rats were anaesthetized with the help of chloroform (30%) and were sacrificed. Blood sample (2ml) were collected from heart. Then blood was centrifuged and supernatant serum was collected and preserved in the refrigerator for biochemical analysis. Serum creatinine and serum urea levels were estimated for assessment of kidney function. Serum levels of creatinine and urea were estimated by fixed time kinetic method¹⁵ and enzymatic colorimetric method¹⁶ respectively.

Statistical analysis

All the data were expressed as mean±SD. Statistical analysis were done by using one way ANOVA followed by post hoc-Bonferroni test. $p < 0.05$ was considered as level of significance.

Results

Percent (%) change of body weight from final to initial was significantly ($p < 0.001$) lower in group A₂ than that of group A₁. Again percent (%) change of body weight was lower in group B in comparison to that of group A₁. Whereas, it was higher in group B than that of group A₂. But the differences were not statistically significant (Table I).

Again, the mean serum creatinine and urea levels were significantly ($p < 0.001$) higher in group A₂ and group B in comparison to that of group A₁. Whereas, these levels were significantly ($p < 0.001$) lower in group B than that of group A₂. (figure 1 and 2).

Table I: Initial and final body weight in different groups of rats (N=45)

| Group | Body weight (g) | | % of change from final (F) to initial (I) body weight [(F-I)/Ix100] |
|-----------------------|------------------------------|-------------------------------|---|
| | Initial (I) | Final (F) | |
| A ₁ (n=15) | 176.07 ± 6.58 (166 - 188) | 211.87 ± 7.76 (200 - 228) | 20.39 ± 3.77 (15.64 - 29.59) |
| A ₂ (n=15) | 177.27 ± 5.80 (168 - 189) | 199.27 ± 14.04 (172 - 221) | 12.33 ± 5.60 (2.38 - 21.02) |
| B (n=15) | 176.87 ± 5.59 (170 - 187) | 205.80 ± 8.48 (195 - 218) | 16.37 ± 3.57 (11.36 - 26.90) |

Statistical analysis

| | Initial body weight p value | Final body weight p value | % of change p value |
|---------------------------------------|-----------------------------|---------------------------|---------------------|
| A ₁ vs A ₂ vs B | 0.857 | 0.008* | 0.000*** |
| A ₁ vs A ₂ | 1.000 | 0.006** | 0.000*** |
| A ₁ vs B | 1.000 | 0.361 | 0.057 |
| A ₂ vs B | 1.000 | 0.285 | 0.052 |

Results are expressed as mean ± SD. Statistical analysis was done by one way ANOVA test followed by post hoc-Bonferroni test. Figures in parentheses indicate ranges; Group A₁: Base line control group; Group A₂: Gentamicin treated control group; Group B: Aloe vera pre treated and gentamicin treated group; N = Total number of rats; * = p< 0.05; ** = p< 0.01, *** = p< 0.001.

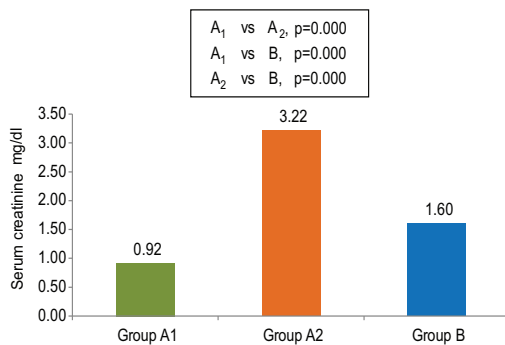


Figure 1: Mean serum creatinine level in different groups of rats. Group A₁: Base line control group; Group A₂: Gentamicin treated control group; Group B: Aloe vera pre treated and gentamicin treated group; Each bar symbolize for mean±SD for 15 rats. *** = p< 0.000 in A₁ vs A₂; *** = p< 0.000 in A₁ vs B; *** = p< 0.000 in A₂ vs B.

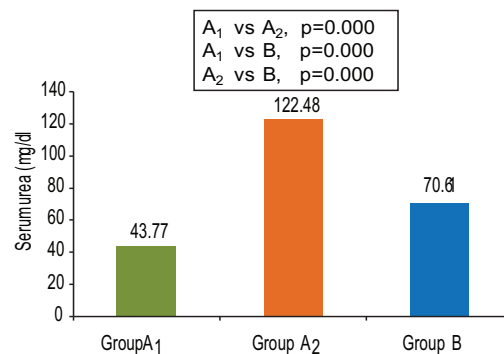


Figure 2: Mean serum urea level in different groups of rats. Group A₁: Base line control group; Group A₂: Gentamicin treated control group; Group B: Aloe vera pre treated and gentamicin treated group; Each bar symbolize for mean±SD for 15 rats. *** = p< 0.000 in A₁ vs A₂; *** = p< 0.000 in A₁ vs B; *** = p< 0.000 in A₂ vs B.

Discussion

In this study, mean serum creatinine and urea levels were estimated to assess renal function. Serum creatinine and urea levels were significantly higher in gentamicin treated group in comparison to those of baseline control group. These findings were similar to the findings reported by the various investigators from different countries^{17,18}. Gentamicin induced production of free radicals might cause lipid peroxidation followed by oxidative stress and subsequent renal damage¹⁹. Whereas, serum creatinine and urea levels were significantly lower in Aloe vera pretreated and gentamicin treated group than those of gentamicin treated control group. Different researchers found similar findings^{12,13}.

Aloe vera prevented the gentamicine induced nephrotoxicity in experimental rats. Some investigators suggested that Aloe vera possesses antioxidants (polyphenols, indules, alkaloids, coumarin, vanillic acid)^{7,10,20}. These antioxidant properties exhibit strong scavenging effect on different free radicals (superoxide, hydroxyl)¹⁰. They inhibit lipid peroxidation¹⁰ and increase superoxide dismutase, catalase enzymes activity and prevent free radical induced renal damage^{9,10}.

In addition, percent change of body weight was significantly lower in gentamicin treated control group than that of baseline control group. This finding is similar to different studies^{18,21}. Some researchers observed that this might be due to loss of appetite by gentamicin injection which results in decrease food intake and ultimately causes loss of body weight²².

In the present study renal damage was observed in rats treated with gentamicin as evidenced by their elevated levels of serum creatinine and urea.

Again lower levels of serum urea and creatinine were observed in rats of Aloe vera pre treated and gentamicin treated group.

The present study suggested that Aloe vera has nephroprotective role against gentamicin induced

nephrotoxicity in rats. This effect is most likely may be due to antioxidant property of Aloe vera.

Conclusion

From the result of the study, it is concluded that, aloe vera has nephroprotective effect on gentamicin induced nephrotoxicity in long evans male rats.

Conflict of interest: None

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