Section A-Research paper
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ROLE OF VITAMIN C THERAPY ON BURN PATIENTS

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Abstract -

Aims and objectives: To investigate the impact of Vitamin C therapy on individuals with burns.

Methodology: The research conducted at the Hospital of Surgery and Burns, Dhule, from January 2020 to October 2021 included 20 adult patients with severe burns (over 30%). Individuals with pre-existing disorders and co-morbid conditions were excluded from the study.

Outcomes: For patients in Group A, the calculated fluid requirement was 3.74 ± 0.57 ml/kg/% of burns, whereas for patients in Group B, it was determined to be 2.46 ± 0.54 ml/kg/% of burns. In terms of urine output, Group A had an average of 1.05 ± 0.28 ml/kg/h, while Group B exhibited a higher urine output of 1.42 ± 0.39 ml/kg/h. Importantly, Group B showed reduced fluid retention and body weight increase compared to Group A.

Conclusions: When high-dose Vitamin C (12-15 grams) is administered as an adjuvant treatment during the first 48 hours of resuscitating burn cases, it has been found to decrease fluid requirement, increase urine production, and reduce fluid retention in the body.

Keywords – *Vitamin C, burns, urine, fluid retention*

Introduction -

Burn wound continues to be a significant healthcare issue in developing nations such as India. Ensuring adequate tissue perfusion through fluid resuscitation, while simultaneously minimizing

edema in severely burned patients, remains a critical and challenging aspect of burn management..[1] In addition to the burned part of the body, the unburnt portion of the body can also experience post-burn edoema. As a result of the onset of a systemic inflammatory response, endothelial dysfunction, and fluid and protein leaks from the intravascular space into the interstitial regio, these develop resulting in serious burns.[2] The phenomenon known as "fluid creep" can give rise to complications in burn injuries, including abdominal compartment condition and pulmonary edema. These complications occur due to the excessive fluid accumulation resulting from inadequate fluid management in burn patients.[3,4] Capillary leakage during burn injury development has been associated with the involvement of local mediators, including histamines, serotonin, prostaglandins, and free radicals. These substances, produced within the affected area, are believed to contribute to the breakdown of capillary integrity and subsequent leakage.[5,7] Emerging research indicates that the formation of free radicals as a consequence of burn injury is significantly implicated in tissue damage and injury.

Tanaka et al. conducted a study involving individuals with burns affecting more than 30% of their total body surface area (TBSA). The cases were distributed into two groups for comparison. Two groups were included in our study. Group 1 received ringer lactate (RL) solution alone, while Group 2 received high-dose of Vitamin C is an 66 mg/kg/h as an adjuvant treatment along with RL solution based on the formula of Parkland for 24 hours.. The study findings demonstrated that the adjunctive management of Vitamin C high-dose, acting as an antioxidant, throughout the initial 24 hours later thermal damage significantly concentrated the volume of resuscitation fluid required.[9]

Saffle[13] The pathophysiology of burn edema involves multiple factors, and the most substantial formation of edema takes place shortly after the burn injury within the wound area. This edema formation is primarily attributed to the nearly complete permeability of the wound, allowing even large molecules (up to 350 Å in size) to leak fluid that closely resembles plasma.

Our research looked at how high-dose vitamin C affected burn victims as an antioxidant adjuvant treatment. We looked into how it affected the amount of fluid needed, fluid retention, urine production, burn-related problems, and other morbidities related to burn damage.

Aims and objectives

The aim of the research is to examine the impact of Vitamin C therapy on burn patients and assess its potential as an indicator of mortality.

Methodology

A randomised, prospective, comparative research on 20 adult burn patients (with TBSA higher than 30%) hospitalised in the burns unit of Shri Bhausaheb Hire Medical College, Dhule from January 1, 2021, to July 31, 2021, was carried out to evaluate how vitamin C affected the amount of the resuscitation fluid. Each patient's informed permission was obtained before to the trial.

Only individuals who reported an injury within 24 hours were included in the research. Randomly selected and evenly split into two groups, A and B. The caregivers involved in the study were aware of the treatment allocation. Group A received resuscitation with RL solution alone, while Group B received RL solution along with Vitamin C. The calculation of resuscitation fluid followed the Modified Parkland's formula, considering the patient's burnt body surface area

Vitamin C were administered through infusion. (12-15 gram for first 24 hours in 500ml DNS over 4-8 hours) along with remaining resuscitation fluid in 24 hours. The quantity of fluid administered through infusion for the purpose of Vitamin C administration was included in the overall volume of resuscitation fluid. To prevent ascorbic acid from oxidising, a black plastic bag was placed around the vitamin C infusion container.

Hourly monitoring was conducted to record different hemodynamic indicators and urine production. To establish hemodynamic stability, defined as a blood pressure in systole (BP) above 100 mmHg and a urine production within the range of 0.5-1.0 ml/kg/h, the rate of resuscitation fluid delivery was modified. Then, a comparison between the two groups was done.

Exclusion criteria

Individuals who met these requirements were excluded from the research.

1) Based on their medical histories, medication histories, and organ-specific function tests available at the time of admission, patients with preexisting hepatic, pulmonary, cardiac, or renal disorders were identified.

2) Additionally, those having previous cases of diabetes were not included in the research.

3) Additionally, patients who reported to the medical facility after 24 hours of the incident and those with inhalation injuries were excluded from the study.

Statistical examination

In contrast to continuous group variables, which are displayed as mean standard deviation, categorical data were expressed as n (%). The t-test was used to compare continuous information between the two groups, while the Chi-square test was utilised to determine the association between categorical variables. A P value of less than 0.05 was used to determine statistical significance.

Outcomes

In current research, the average age of individuals in Group A remained 35.0 years, while in Group B, it was 40.2 years. Nevertheless, this disparity did not yield any statistically significant results. Similarly, there was no statistically significant difference observed in terms of gender distribution among the two groups.

Regarding the average extent of burned body surface area, it was 45.7% in Group A and 43.8% in Group B. However, the observed difference among the both groups was not deemed statistically significant according to the data presented in Table 1.

In Group A, which received treatment with RL alone, the average fluid requirement during the initial 24 hours to achieve hemodynamic stability and sufficient urine output was 3.7 ml ± 0.6/kg/% of burn. In contrast, the amount of fluid needed in Group B, which received treatment with both RL and Vitamin C, was 2.5 ml 0.5/kg/% of burn. Importantly, this disparity was determined to be statistically significant ($P < 0.001$) according to the data presented in Table 2.

Additionally, within Group A, the urine output during the initial 24 hours of resuscitation amounted to 1.1 ml ± 0.3/Kg/h, while in Group B, it measured 1.4 ml ± 0.4/Kg/h. This dissimilarity was found to be statistically significant ($P = 0.006$) based on the information provided in Table 2.

The calculation of fluid retention in the body, which involved subtracting the total fluid intake from the total fluid output in the first 24 hours, yielded a value of 122.6 ± 40.7 in Group A and 81.2 ± 63.8 in Group B. This difference was marginally significant ($P = 0.051$) [Table 2].

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Table 1: Age, gender, and % of burn part of cases in both groups

	Group A (RL)	**Group B (RL + Vitamin C)**	***P value***
Age (years), mean±SD	35.0±18.6	40.2±14.3	0.399
Sex, *n* (%)			
Female	3 (30.0)	4 (40.0)	0.605
Male	7 (70.0)	6 (60.00)	
Percentage of total body surface area			
Percentage of burn	45.7 (12.6)	43.8 (17.7)	0.565

RL: Ringer lactate, SD: Standard deviation

Table 2: Comparison of Parameters in the Two Groups during the Initial 24 Hours of Resuscitation

Parameter noted	**Group A (RL)**	**Group B (RL + Vitamin C)**	***P value***
Fluid requirement (ml/kg/%burn)	3.7±0.6	2.5±0.5	<0.001
Urine output (ml/kg/h)	1.1±0.3	1.4±0.4	0.006
Fluid retention (ml/kg)	122.6±40.7	81.2±63.8	0.051

Table 3: Complications in the two group

Complications	**Group**	**Group**	**Total,**	***P value***
	Group A (RL), *n (%)*	Group B (RL + Vitamin C), *n (%)*	***n (%)***	
Pneumonia/pulmonary edema	6 (40.00)	4 (26.67)	10 (33.33)	0.439

RL: Ringer lactate

Result -

In our study, the recovery rate was observed to be 53.33% in the Vitamin C group, related to 40.00% in the RL. No one of the individuals in either group experienced renal failure. The

incidence of pneumonia was recorded as 26.67% in the group of Vitamin C and 40% in the RL group [Table 3]. However, none of these differences reached statistical significance.

Discussion -

In major burn trauma cases, the standard practice for initial fluid resuscitation involves administering intravenous infusion of crystalloid solutions. This is done to address hypovolemia and improve peripheral tissue perfusion [14]. Monitoring the effectiveness of resuscitation is typically done by assessing urine output, which should be within the range of body weightof 0.5-1.0 ml/kg/h, and ensuring a constant hemodynamic status. However, According to reports of excessive fluid administration in burn patients, resulting in complications such as pneumonia, prolonged mechanical ventilation, abdominal compartment syndrome. This phenomenon has been referred to as "fluid creep."

In their study, Fang et al. provided an explanation that thermal injury leads to the generation of free radicals from different cellular populations. They further suggested that modulating the activity of these free radicals through the use of scavengers might potentially improve the overall outcome. [15]

Horton provided an explanation regarding the role of free radicals in causing cellular damage. According to his research, after a burn injury, there is an elevation in Product levels of lipid peroxidation at both systemic and tissue levels particularly MDA levels. It has been observed that administering antioxidant therapy to burn patients can effectively decrease mortality rates associated with burns and sepsis. In conclusion, Horton's study supports the notion that employing antioxidant strategies to counteract the excessive production of free radicals can minimize tissue damage, enhance organ function, and ultimately lead to improved patient outcomes. [14]

Our study aimed to investigate the impact of antioxidant therapy, specifically Vitamin C, on reducing fluid requirements in burn patients. We enrolled a total of 20 patients with burns and separated them into two groups: Group A, which received only RL solution, and Group B, which received Vitamin C as an adjuvant treatment during resuscitation. In the first 24 hours of resuscitation, Group A patients required an average of 3.74 ± 0.57 ml of fluid per kilogram per percentage of burn area, whereas in a B Group 2.46 ± 0.54 ml of liquid required per kilogram per percentage of burn, which was a significant difference ($P < 0.001$). The fluid requirement in the group of Vitamin C was 34.3% lower related to the RL group.

A research done by Tanaka et al., they found that the RL group needed 5.5 3.1 ml/kg/% of burns of fluid while the Vitamin C group needed 3.0 1.7 ml/kg/% of burns of fluid. Their research showed that individuals receiving vitamin C had a 45.5% lower first resuscitation fluid volume. [16]. Similar results were found by Kahn et al. in their investigation, which showed that the fluid needs in the 24 hours were 7.1 1 ml/kg/% TBSA for the RL group and TBSA is 5.3 1 ml/kg/% for the group of Vitamin C. Both of these results were statistically significant (P 0.05).[17]

The effectiveness of high-dose ascorbic acid therapy in lowering edoema development and fluid needs during resuscitation was proven by Matsuda et al. in an animal model. The 24-hour fluid resuscitation amount was significantly reduced to 32.5% of the Parkland formula in a subsequent research, with sufficient cardiac output levels being maintained. [18].

Despite obtaining a larger fluid volume in our research, Group A patients had substantially lower urine output (1.05 0.28 ml/kg/h) than Group B patients (1.42 0.39 ml/kg/h) ($P = 0.006$). [16].

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Regarding fluid retention, Group A patients exhibited significantly more body weight gain (122.6 ml/kg) after 24 hours compared to Group B patients (81.2 ml/kg), and this difference was statistically significant. Higher fluid retention in the RL group (162 ± 87 ml/kg) compared to the Vitamin C group (89 ± 97 ml/kg) also reported by Tanaka et al. [16]. Fluid retention in the body is indicative of fluid loss to the extravascular space, which contributes to burn shock and related complications. Treatment with Vitamin C resulted in less fluid retention, likely due to its protective effect on capillary endothelium.
According to Demling's research, antioxidants given during the first stage of resuscitation inhibit the creation of edoema by scavenging free radicals in the blood. [19].

The hemodynamic status of both groups in our study, which encompassed blood pressure, pulse rate, respiratory rate, oxygen saturation, and body temperature, demonstrated similarity. There were no notable variances in vital parameters or stability observed during the administration of high-dose Vitamin C to patients. These findings imply a potential reduction in capillary leakage and the preservation of sufficient blood pressure within the Vitamin C group.

Conclusion -

To revive burn patients during the first 48 hours, high-dose Vitamin C (12–15 grammes) was given as adjuvant treatment in our investigation. We saw that this therapeutic strategy reduced the need for fluids, increased urine production, and decreased fluid retention in the body. It was discovered that vitamin C was harmless and quickly excreted from the human body in a few hours. The hospitalised mortality rate among patients with severe burns was also shown to be lower when vitamin C treatment was used, particularly when a minimum dose of 10 grammes was given during the first two days of admittance.
While our observational research provides unique insights into the ongoing debate surrounding Vitamin C administration in burn victims, further prospective studies are necessary to obtain additional clarification on this matter.

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