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Original Research Article

A prospective observational study on bolus administration of high-dose nitroglycerin in treating sympathetic collapsing acute pulmonary oedema

Chhatray Marndi[1], Ashok Kumar Behera[1], Gopabandhu Patra[2], Saubhagya Chhotaray[3]*

[1]Department of General Medicine, Bhima Bhoi Medical College and Hospital, Balangir, Odisha, India
[2]Department of Orthopaedics, Bhima Bhoi Medical College and Hospital, Balangir, Odisha, India
[3]Department of Emergency Medicine, Bhima Bhoi Medical College and Hospital, Balangir, Odisha, India

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***Correspondence:**
Dr. Saubhagya Chhotaray,
E-mail: ramdas07482@gmail.com

ABSTRACT

Background: Sympathetic crashing causes sudden cardiac failure in minutes or hours. Early diagnosis and treatment may avoid acute heart failure fatalities. Sympathetic crashing reduces afterload, shifting fluid into the pulmonary circulation and causing pulmonary edema. The usual strategy of progressively increasing vasodilator dosage has increased preload. Treating SCAPE with large doses of nitroglycerin and non-invasive breathing is helpful. High doses of nitroglycerin boost afterload and eliminate ICU admissions. In this study, a standard protocol for the treatment of patients with sympathetic crashing acute pulmonary edema is assessed for its effectiveness.
Methods: An observational study was conducted prospectively at Bhima Bhoi Medical College and Hospital in Balangir, Odisha, India over the course of a year. The patients presenting with SCAPE symptoms were treated according to standard protocol. The outcomes were subjected to statistical analysis to derive a correlation between treatment and response.
Results: The mean initial bolus given to all the patients was 836 µg. The total cumulative dose of nitroglycerin used in each patient was 36 mg. The symptoms of most of the patients resolved within the first 6 hours of treatment.
Conclusions: The standard protocol developed at the institute, which included a high dose of nitroglycerine along with non-invasive ventilation, was efficient in treating acute heart failure due to sympathetic crashing and acute pulmonary edema. Nitroglycerin, along with non-invasive ventilation, should be used in the management of sympathetic crashing pulmonary edema and acute heart failure.

Keywords: High-dose nitroglycerin, Non-invasive ventilation, Sympathetic crashing, Acute pulmonary edema

INTRODUCTION

Sympathetic crashing pulmonary edema is a type of acute hypertensive heart failure. It is characterized by respiratory distress, a marked increase in blood pressure, edema in the lungs, and sympathetic symptoms such as agitation.[1]

The development of acute heart failure due to sympathetic crashing occurs within minutes to hours. Timely recognition of the severity of acute heart failure and optimum treatment can prevent its progression and reduce mortality.[2]

During sympathetic crashing, the afterload decreases substantially, leading to a shift of the fluid into the pulmonary circulation, which eventually causes pulmonary edema. The venous tone and arterial tone are affected during the event; this is due to a surge in the release of catecholamine.

Vasodilators are preferred by emergency physicians to address such an event.[3] However, the traditional method of increasing the dose of vasodilators gradually has been effective in increasing the preload. An increase in the

preload worsens the condition of sympathetic crashing instead of arresting its progression.

Studies reveal that administration of a high dose of a vasodilator, specifically nitroglycerin, followed by a tapering dose along with non-invasive ventilation is effective in treating sympathetic crashing acute pulmonary edema.[4,5]

A high dose of nitroglycerin increases the afterload, and it also eliminates the need for ICU admission of the patients. A standard protocol development and treatment can significantly reduce mortality due to acute heart failure.

In this study, a standard protocol for the treatment of patients with sympathetic crashing acute pulmonary edema is assessed for its effectiveness. The standard protocol includes identification of the symptoms and treatment with high-dose nitroglycerin paired with non-invasive ventilation.

METHODS

Study design

An observational study was conducted prospectively at Bhima Bhoi Medical College and Hospital in Balangir, Odisha, India over the course of a year.

Participants

Patients with an age above 18 years presenting with peculiar symptoms of sympathetic crashing pulmonary edema, which included more than 30 breaths per minute, acute respiratory distress that developed within, the last 6 hours, oxygen saturation less than 90%, and blood pressure more than 160/100 mm of Hg were included in the study. Patients who took vasodilators less than 24 hours ago, who had coronary syndrome, and who had an allergy to nitroglycerin were excluded from the study.

Standard protocol

The patients with the above-mentioned clinical presentations were given 600-1000 µg of nitroglycerin over 2 min. Then 100 µg were given in an infusion, and it was titrated according to the systolic blood pressure response. Simultaneously, non-invasive positive pressure ventilation was started, and the pressure was maintained according to the respiratory response.

An ultrasound was performed on the patients immediately after presenting in the emergency department, and vitals were also measured. Vitals were measured after that every 10 min and then hourly for six hours. During the protocol, if there was a sudden decrease in the blood pressure and worsening of the symptoms, the protocol was stopped immediately, and normal saline was given instead. When the presented symptoms were resolved, that is, breath was less than 24 per min, systolic blood pressure was less than 160 mm Hg, and oxygen saturation was more than 90% at room air, patients were given oral antihypertensives to reduce the blood pressure.

The feasibility of the NTG along with the NIV in treating SCAPE was determined. If the symptoms resolved within 6 hours of treatment, it was successful, and if adverse events developed, they were reported. In either case, the cases were calculated.

Ethical consideration

Ethical clearance was obtained from the institutional ethics committee.

Statistical analysis

The data obtained was subjected to statistical analysis, and correlation was determined to assess the efficacy of the treatment.

RESULTS

Twenty patients participated in the study who presented the symptoms of sympathetic crashing and acute pulmonary edema. 12 were male, and 8 were female among them. The mean age of the patients was 44 years. All of them had one or more comorbidities associated with hypertension.

The mean initial bolus given to all the patients was 836 µg. The total cumulative dose of nitroglycerin used in each patient was 36 mg. All the patients were admitted to the emergency department during the night. Table 1 illustrates the hemodynamic response to the treatment. It gives the mean of the parameters measured in all the patients.

The ultrasound of all the patients showed a B-profile in the lungs which indicates pulmonary edema. 50% of the patients had reduced contraction of the heart which was found from the ultrasound of the inferior vena cava.

The positive pressure was maintained at 12 cm in the inspiratory and 6 cm in the expiratory. However, 5 patients among the 20 required increased inspiratory and expiratory pressure.

50% of the patients required opioid treatment due to intolerability of the NIV mask. 1 of the patients was still not able to tolerate the mask so he was intubated and shifted to the intensive care unit.

The symptoms of most of the patients resolved within the first 3 hours of the treatment although some patients required up to 6 hours to recover in response to the treatment of nitroglycerin with non-invasive ventilation. The p value was calculated for the response achieved and the treatment given, and it was less than 0.05 which indicated that the correlation was significant.

Table 1: Hemodynamic response to the treatment.

Parameters	Respiration	Partial oxygen saturation	Blood pressure		Pulse rate
			Systolic	Diastolic	
During admission	41	80	200	112	129
1 hour after treatment	29	99	181	109	119
3 hours after treatment	31	99	169	99	107
6 hours after treatment	25	99	141	85	91
During discharge	21	99	129	80	80

DISCUSSION

The standard protocol which included treatment with nitroglycerine and non-invasive ventilation for the patients with acute heart failure due to sympathetic crashing acute pulmonary edema was proven to resolve symptoms efficiently.

As the patient reported during the nighttime most of them had chronic kidney disorders associated, the nocturnal secondary hypertension due to kidney diseases can be the reason for nocturnal sympathetic surge. In a similar study conducted 400 µg infusion was given which was then tapered to lower doses.[6] On the contrary, in this study, an initial high dose of nitroglycerin was given and later on 100 µg infusion was given which was modified according to the hemodynamic response.[7] 200 µg of infusion can efficiently resolve the symptoms. The symptoms of all the patients resolved within 6 hours of treatment. Two individuals had temporary hypotension that responded to a minor fluid bolus. This may be because these individuals had apparent pulmonary oedema yet were volume deficient when ultrasonography showed >50% collapsible IVC. Chronic hypertension and diuretic use may cause systemic hypovolemic conditions in hypertensive heart failure patients. Volume-depleted patients may have substantial hypotension with high-dose NTG.

Here only one patient was intubated due to intolerability of the NIV mask. In a similar study, more patients were intubated on the contrary the other showed that no patients were intubated.[8,9] The intubation when the patient cannot tolerate the NIV mask. Generally, in case of acute heart failure, non-invasive ventilation is the preferred treatment option however in case of sympathetic crashing acute pulmonary edema the patient is agitated and in respiratory distress. To relieve the agitation sedatives can be used or opioids can be used as anxiolytics.[10] Also counselling the patient to comply while holding the mask can prevent the need for intubation.

The sudden decrease in the pressure as an adverse effect of high-dose nitroglycerin was not reported in any of the cases.

Limitation

This study monitored the immediate adverse effects of high nitroglycerin and not the long-term effects of the same. Also, the study included small population size and did not consider correlation with other comorbidities.

CONCLUSION

The standard protocol developed at the institute which included a high dose of nitroglycerine along with non-invasive ventilation was efficient in treating acute heart failure due to sympathetic crashing acute pulmonary edema.

Recommendation

Nitroglycerin along with non-invasive ventilation should be used in the management of sympathetic crashing pulmonary edema acute heart failure.

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