J Ped Nephrol
Journal of Pediatric Nephrology
2024. Volume 12

Case Report

Multiple Organ Dysfunction Syndrome Secondary to Multiple Wasp Stings: A Case Report

Farhana Akter[1], Jannatus Sabiha[1*], Mostafa Kamal[1], Tahmina Jesmin[1], Delwar Hossain[1], Syed Saimul Huque[1]

1. Department of Pediatric Nephrology, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh.

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Citation Akter F, Sabiha J, Kamal M, Jesmin T, Hossain D, Huque SS. Multiple Organ Dysfunction Syndrome Secondary to Multiple Wasp Stings: A Case Report. Journal of Pediatric Nephrology. 2024; 12:E44425. http://dx.doi.org/10.22037/jpn.v12i1.44425

http://dx.doi.org/10.22037/jpn.v12i1.44425

Article info:
Received: 14 Jan 2024
Accepted: 12 Mar 2024
Publish: 06 May 2024

Corresponding Author:
Dr. Jannatus Sabiha, Resident.
Address: Department of Pediatric Nephrology, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh.
E-mail: js.smrity14@gmail.com

ABSTRACT

Background and Aim: Wasp stings can cause life-threatening conditions if not promptly managed. Symptoms can vary from local reactions to severe multi-organ dysfunction, such as acute kidney injury (AKI), acute liver failure (ALF), rhabdomyolysis, pulmonary edema, respiratory failure, hematological and neurological involvement, and even death. Emergency interventions are often needed. The purpose of this report was to increase awareness among clinicians about possible complications of wasp stings in order to provide early detection and proper management.

Case Presentation: A six-year-old girl had been suffering from multiple wasp stings. She was diagnosed with multiple organ dysfunction syndrome (MODS), including hemolysis, AKI, liver injury, and respiratory failure. She was managed with renal replacement therapy and was ultimately discharged with normal renal function.

Conclusion: Children with multiple wasp stings should be referred earlier for the initiation of proper management to improve the outcomes.

Keywords: Multiple organ dysfunction syndrome, Rhabdomyolysis, Venoms, Acute kidney injury

J Ped Nephrol
Journal of Pediatric Nephrology

Introduction

Wasp, or gardener's friend, is not uncommon worldwide [1]. Stings are more common in males than in females, likely because of increased occupational and recreational exposure. Stinging incidents are more frequent during late summer and early fall [2].

Wasp venom is a complex mixture of proteins, peptides, and low molecular weight components. Venom contains up to 13 different antigens, such as phospholipase A2, hyaluronidase, melitin, apamin, chemotactic peptides, histamine, dopamine, serotonin, and catecholamine. Toxins have vasoactive properties. The most important substance in wasp toxins is the enzyme phospholipase A2 and its product (lysolecithin), which affect the phospholipids of the cell membrane, mitochondria, and lysosomes of any organ. Therefore, these toxins can cause multisystem involvement [3]. The skin is the most commonly affected organ. Other organs affected include the kidneys, liver, heart, brain, and blood. Multiple organ dysfunction syndrome (MODS) following wasp stings is uncommon, and when it happens, carries a worse prognosis. In adults, mortality among those with acute kidney injury (AKI) after a wasp sting is as high as 25% [4-7].

In Bangladesh, the incidence of childhood wasp stings is not well documented, as only occasional case reports exist. The purpose of this report was to alert clinicians to be aware of the systemic involvement caused by wasp stings in children, as most children who have suffered from multiple wasp stings need emergency medical attention. Clinicians should be aware of possible complications of wasp stings in order to provide early detection and proper management.

Case Presentation

A six-year-old girl was admitted to Bangabandhu Sheikh Mujib Medical University (BSMMU) with complaints of multiple wasp stings all over her body five days prior. She developed oliguria followed by anuria and generalized swelling of the body over four days. She also developed yellowish discoloration of skin and sclera, as well as unconsciousness over the last three days. She had no history of headaches, seizures, bleeding manifestations, and taking any offending drugs.

On examination, she was unconscious, with a Glasgow coma scale (GCS) score of 4/15 (eye: 1, motor: 1, and verbal: 2), a puffy face, mild pallor, and moderate icterus. On the skin survey, there were multiple marks of wasp stings (n=109) on the whole body. She was tachypneic (respiratory rate [RR]: 44 breaths/min), with a oxygen saturation (SpO_2) of 96% on 10 liters of oxygen, a pulse of 80 beats/min, and was hypertensive (blood pressure [BP]: 140/80 mmHg, >99th centile). The apex beat was shifted, and bilateral basal crepitations were present, along with tender hepatomegaly (liver enlarged by 7 cm from the right costal margin), bipedal pitting edema, and signs of ascites. The flapping tremor was absent and deep tendon reflexes were equivocal. Other systemic examinations revealed no abnormalities. She was initially diagnosed with AKI due to wasp stings, accompanied by heart failure and encephalopathy (uremic or hepatic).

A list of investigations was planned that included urine R/M/E, serum creatinine, serum urea, serum electrolytes, complete blood count, peripheral blood film (PBF), serum glutamate pyruvate transaminase (SGPT), serum bilirubin, serum albumin, prothrombin time (PT), international normalized ratio (INR), activated partial thromboplastin time (APTT), serum Lactate Dehydrogenase (LDH), creatine kinase (CPK), and renal biopsy. Investigations showed raised blood urea and creatinine (Table 1). Complete blood count (CBC) showed anemia, and neutrophilic leukocytosis with thrombocytopenia (Table 2). Urinalysis showed microscopic hematuria and proteinuria. Serum electrolytes indicated hyperkalemia with metabolic acidosis. Liver function tests were deranged (Table 3). Serum CPK and LDH levels were elevated (Table 4). Chest X-ray revealed pulmonary edema (Figure 1) and ultrasound of the kidneys, ureters, and bladder (USG KUB) showed the right kidney measuring 7.6×3.6 cm and the left kidney measuring 7.8×3.2 cm, with increased cortical echogenicity and maintained corticomedullary differentiation; the comment was: "Bilateral renal parenchymal disease".

The patient was managed by keeping her nothing per oral (NPO) and administering glucose-containing IV fluid (as the patient was unconscious), injectable hydrocortisone, injectable antibiotics (cefotaxime), injectable vitamin K, injectable $NaHCO_3$, injectable calcium gluconate (for hyperkalemia), injectable furosemide (for heart failure), and oral antihypertensive medication via an NG tube. Intermittent peritoneal dialysis (IPD) was started immediately, but IPD could not continue for more than 12 hours due to technical difficulties.

With all aseptic precautions, a central venous line was introduced through the right internal jugular vein (IJV), and intermittent hemodialysis (IHD) was initiated along with packed cell transfusion. After the fourth session of dialy-

Table 1. Biochemical report during admission

Parameters		Values
Parameters	Urea (mg/dl)	349.3
	Creatinine (mg/dl)	7.1
Electrolytes	Na^+ (mmol/L)	136
	K^+ (mmol/L)	7.0
	Chloride	101
	TCO_2 (mmol/L)	9.9
Calcium (mg/dl)		6.5
Uric acid (mg/dl)		19.9
Albumin (mg/dl)		28

sis, the patient was semi-conscious, with a Glasgow Coma Scale (GCS) score of 10/15 (improving), an SpO_2 of 98% with 6L of O_2, and normal vital signs. The intake was 1100 ml, output was 60 ml, and bedside urine albumin (BSUA) was 2++. The biochemical report showed that serum creatinine, urea, SGPT, and LDH were in decreasing trend. The injectable steroid was then switched to oral prednisolone (2 mg/kg/day) for suspected interstitial nephritis. A renal biopsy was done, and the report revealed tubular atrophy, casts of RBCs, myoglobin, fibrin deposition: 3+, and the diagnosis of "acute tubular injury".

After five days of HD, the patient's urine output was adequate. A total of nine sessions of HD were given, and then the patient was prepared for discharge. At the time of discharge, the diagnosis was MODS secondary to multiple wasp stings, and the treatment prescribed included tab prednisolone 15 mg/day for seven days, followed by a gradual taper, an antihypertensive (single drug), and a multivitamin. Fifteen days later, the patient came to the outpatient department (OPD) for a follow-up with some investigations (Table 5). The patient showed improvement in both clinical and laboratory findings (Figures 2).

Discussion

Wasp venom can affect multiple systems in the human body. It may vary from local reactions (pain and swelling) to anaphylactic shock, AKI, acute liver failure (ALF), rhabdomyolysis, myocardial infarction, arrhyth-

Table 2. CBC report at the time of admission

Parameters	Results
Hb (gm/dl)	8.7
ESR (mm in 1st hour)	40
WBC ($\times 10^9$/L)	20
Neutrophil (%)	90
Lymphocyte (%)	5
Monocyte (%)	3
Eosinophil(%)	2
Platelet	70
PBF ($\times 10^9$/L)	Normocytic normochromic anemia with thrombocytopenia

Abbreviations: CBC: Complete blood count; Hb: Hemoglobin; ESR: Erythrocyte sedimentation rate; WBC: White blood cell; PBF: Peripheral blood film.

J Ped Nephrol
Journal of Pediatric Nephrology

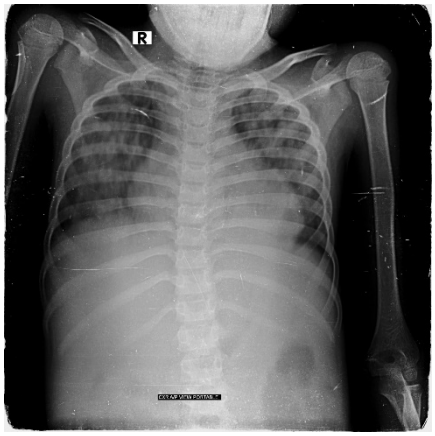


Figure 1. Chest X-ray: Suggestive of pulmonary oedema

mia, pulmonary edema, respiratory failure, hematological involvement (anemia, thrombocytopenia, and leukocytosis), and neurological complications [8].

Allergic reactions from wasp stings usually occur shortly after the stings. Serious and less common systemic manifestations, including MODS, can also occur within 24 hours or at a later time [8, 9].

In developed countries, patients with one or a few stings usually experience allergic reactions of varying degrees. In contrast, individuals in developing countries, including India, Vietnam, Thailand, Malaysia, and Nepal, who are attacked by swarms of wasps are more likely to undergo a life-threatening toxic reaction in response to the venom [6, 7, 10-12].

The severity of clinical manifestations is related to the number of stings (more than 50 stings are considered fatal, and around 500 stings are lethal), the timing of sting removal, the time from the sting to reaching the hospital, the strength of the venom, and the susceptibility of children. Xie et al. showed that hospital mortality was significantly higher (five times) in the group with more than ten stings compared to that in the group with fewer than ten stings [13]. On the other hand, Watana et al. showed that about 500 stings may be fatal to an adult; even as few as 30–50 stings can lead to fatalities in children, and anaphylactic shock can occur in a previously sensitized person following even a single sting [14]. In our presented case, the number of stings was around 109.

Several mechanisms are responsible for venom-induced AKI, which include acute tubular necrosis (ATN), acute interstitial nephritis (AIN), and pigment nephropa-

Table 3. Urine report during admission

Parameters		Results
Color		Straw
Protein		+++
Pus cell (/HPF)		0-5
RBC (/HPF)		10-12
Cast		Not found
Pus cell (/HPF)		1-3
Urine culture and sensitivity	RBC (/HPF)	5-6 (No growth)
	Urinary eosinophil	Not found

RBC: Red blood cell

Table 4. Liver function test during admission

Parameters	Results
SGPT (U/L)	4390 (↑↑ed)
Bilirubin (total) (mg/L)	16.8 (↑↑ed)
PT (sec.)	27.1
INR	2.73 (prolonged)
APTT (sec.)	35.5
Albumin (mg/L)	28
LDH (U/L)	2012 (↑↑ed)
CPK (U/L)	2423 (↑↑ed)

Abbreviations: SGPT: Serum glutamate pyruvate transaminase; PT: Prothrombin time; INR: International normalized ratio; APTT: Activated partial thromboplastin time; LDH: Lactate dehydrogenase; CPK: Creatine kinase.

Note: ↑↑ed shows increased.

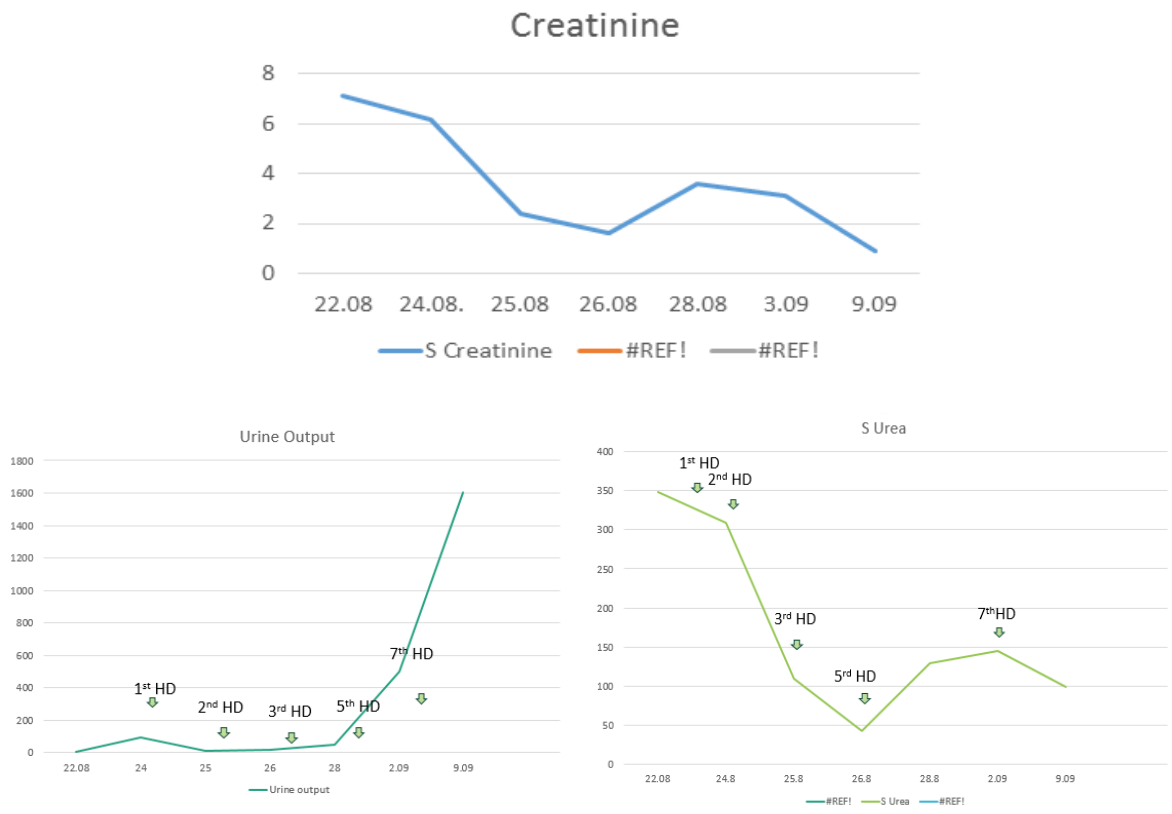
thy resulting from rhabdomyolysis (myoglobinuria) or intravascular hemolysis (hemoglobinuria), as well as hypotension caused by an anaphylactic reaction [15]. Direct toxicity of the venom to muscles and subsequent myoglobinuria may be important factors contributing to AKI. Myoglobin, released from muscles, induces AKI by exerting toxic effects on tubular epithelial cells through intralobular cast formation or pigment nephropathy. Atmaram et al. showed that seven out of the 12 cases of wasp stings had rhabdomyolysis. A CPK level greater than 5,000 U/L is associated with AKI [16-20]. In our case, CPK and LDH levels increased significantly,

Table 5. Investigations during the follow-up period

Parameters	Results
Electrolytes	
Na^+ (mmol/L)	138
K^+ (mmol/L)	3.7
Chloride (mmol/L)	107
TCO_2 (mmol/L)	24.0
Spot testing with PCR	0.21
Albumin (mg/L)	41
Urea (mg/L)	41
Creatinine (mg/dl)	0.43
SGPT (U/L)	101.1 (decreasing)
LDH (U/L)	1224
PT (sec.)	13.8
INR	1.15

Abbreviations: PCR: Protein creatinine ratio; SGPT: Serum glutamate pyruvate transaminase; LDH: Lactate dehydrogenase; PT: Prothrombin time; INR: International normalized ratio.

J Ped Nephrol
Journal of Pediatric Nephrology



Figures 2. Serial assessment of renal function

reaching peaks of 2423 U/L and 2012 U/L, respectively, which indicates the presence of hemolysis and rhabdomyolysis, although urinary myoglobin levels were not evaluated. Urine RBCs were present in routine examination, and clinically, the patient had anemia; the peripheral blood film showed normocytic normochromic anemia with thrombocytopenia. The patient's liver function deteriorated, with evidence of raised SGPT, bilirubin, and PT, indicating hepatic damage with coagulopathy. All these events contributed to AKI. When renal function deteriorates or does not improve, a renal biopsy is recommended to determine the exact cause of AKI [21]. ATN and AIN are common findings in renal histopathological examinations [13, 21, 22]. The report for our presenting patient indicated acute tubular injury, tubular atrophy, and the presence of RBC casts, myoglobin, and fibrin deposition: 3+.

Our patient presented with several complications that were supported by laboratory evidence of hemolysis, rhabdomyolysis, AKI, liver injury, and pulmonary edema. We established the diagnosis of MODS secondary to wasp venom based on the clinical findings, despite the absence of evidence of acute respiratory distress syndrome (ARDS). The mechanism of multiorgan damage may be related directly to the effects of the toxins or indirectly to the excessive systemic inflammatory response on organ tissues [23].

Life-threatening conditions can occur following wasp stings if not promptly diagnosed and managed. The outcome depends on factors, including the severity of complications, involvement of different organs, and the time interval between getting stung and hospital admission, as well as effective management [14, 24, 25].

Treatment is supportive and includes adequate fluid resuscitation, maintenance of hemodynamic stability, and proper nutritional support to enhance recovery, as there is no specific treatment for wasp stings, and wasp venom has no antidote [14, 24, 25]. In severe cases, renal replacement therapy (RRT), such as intermittent hemodialysis or peritoneal dialysis, may be needed due to electrolyte imbalance, uremia, and fluid overload [5]. In multiple organ failure following wasp stings, plasma exchange with continuous veno-venous hemofiltration has been suggested [5, 13].

Xie et al. showed in their multicenter, retrospective study that patients who attended hospital late (>4 h), had

multiple wasp stings (≥20 stings), and developed AKI could have a good outcome when HD was performed immediately [13]. Although our patient had a delayed referral (five days after the incident) to the tertiary hospital, immediate dialysis successfully eliminated wasp toxins and helped achieve early recovery of kidney function.

In most cases, renal function became normal in surviving cases within three months [13, 21, 22]. Our reported patient received nine sessions of HD through IJV, and urine output was established after five days of HD sessions.

The role of steroids in the management of wasp stings is debatable; however, steroids reduce interstitial fibrosis in acute interstitial nephritis, leading to early renal recovery and preventing irreversible kidney damage [21]. Our patient was also treated with prednisolone due to a suspicion of AIN. The recovery rate in AIN was much longer than in ATN (66.5 versus 35.6 days) and may result in interstitial fibrosis and irreversible renal failure if not promptly treated [21].

Conclusion

It can be concluded that children with multiple wasp stings should be referred earlier for the initiation of proper management to improve the outcomes. Although kidney impairment usually occurs within the first few days, adequate intravenous fluid may slow the progression of renal damage, and steroid administration may be beneficial in reducing interstitial fibrosis. Immediate renal replacement can improve renal function and also provide a good prognosis.

Ethical Considerations

Compliance with ethical guidelines

Informed consent was obtained from the patient.

Funding

This research did not receive any grant from funding agencies in the public, commercial, or non-profit sectors.

Authors' contributions

All authors equally contributed to preparing this article.

Conflict of interest

The authors declared no conflict of interest.

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J Ped Nephrol
Journal of Pediatric Nephrology

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