



## CASE REPORT

# Acute Kidney Injury Following Star Fruit Ingestion: A Case Series

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Star fruit (*Averrhoa carambola*) is a popular fruit in many tropical countries, including Sri Lanka. It is rich in oxalic acid, which is nephrotoxic in higher concentrations. The development of both acute (AKI) and chronic kidney injury after oxalate nephropathy is often underrecognized. Here we discuss the risk factors, clinical features, treatment, and outcomes of 4 patients who developed AKI after star fruit ingestion. Baseline clinical characteristics, the amount of star fruit ingested, clinical presentation, investigation, and outcome of the patients (ages 28, 50, 54, and 55 y; all male) were traced. More common symptoms of acute star fruit intoxication were nausea, vomiting, and abdominal and back pain, followed by low urine output and high serum creatinine over hours to days. Urinary analysis of all patients demonstrated oxalate crystals. Histopathologic examination of renal tissues of all 4 patients revealed acute tubular damage with calcium oxalate crystals, interstitial edema, and inflammatory cellular infiltration. The presence of calcium oxalate crystals was further confirmed with the brilliant birefringence seen under polarized light. Two patients needed intermittent hemodialysis over a week owing to oliguria and uremia. The other 2 patients did not require hemodialysis and had improvement of renal function with supportive treatment. All had high renal function on discharge but were back to normal within a month. This study highlights AKI as a serious complication of star fruit ingestion. The type and quantity of star fruit ingested and some patient factors may play a role in the pathogenesis of AKI. Public education about this serious uncommon complication is important.

**Keywords:** *Averrhoa carambola*, nephrotoxic, calcium oxalate, acute tubular damage

## Introduction

Star fruit (*Averrhoa carambola*), which belongs to the family Oxalidaceae, is popular in Sri Lanka and many tropical countries such as Taiwan, Thailand, and Brazil<sup>1,2</sup> (Figure 1). There are 2 main types of star fruit, particularly based on flavor: sour and sweet types. The sour type contains far more oxalate than the sweet type.<sup>1-3</sup> In Sri Lanka, the fruits are available throughout the year and contain a juicy edible portion consumed as a raw fruit, freshly prepared juice, or in salads or curries. Star fruit

is believed to possess antidiabetic properties, according to local medicinal practitioners, and hence is a very popular food in Sri Lanka and the Indian subcontinent. Star fruit is rich in oxalic acid, which is nephrotoxic in higher concentrations, and caramboxin, a potential neurotoxin, which can lead to confusion and seizures.<sup>2</sup>

Deposition of oxalate crystals in renal tubules can cause acute and chronic renal tubular injury and interstitial fibrosis.<sup>4,5</sup> It takes several hours to days for acute kidney injury (AKI) to develop, and consumers may not be aware of a connection between consumption of star fruit and AKI. Patients may present with generalized edema, oliguria, confusion, and cardiac arrhythmias, depending on the severity of AKI. Unrecognized AKI may progress to death.<sup>6,7</sup>

Excessive consumption of star fruit has rarely been associated with the development of AKI in persons with

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Submitted for publication May 2020.

Accepted for publication November 2020.



**Figure 1.** Sour star fruit.

normal renal function. It is believed that the amount of star fruit ingested, pre-existing impairment of renal function, and dehydration are risk factors for development of star fruit-associated toxicities.<sup>8</sup> Star fruit consumption among patients on dialysis can result in severe complications and fatalities.<sup>7-10</sup>

Development of AKI after star fruit consumption among normal individuals is a rare event. However, star fruit-induced oxalate nephropathy in both acute and chronic kidney disease is often underrecognized. In this case series, we discuss the risk factors, clinical features, treatment, and outcome of 4 previously healthy patients who developed AKI after ingestion of star fruit.

## Methods

This retrospective study reviewed the hospital records of patients who developed AKI after ingestion of star fruit. The records were from a tertiary care hospital in Sri Lanka for patients presenting from June 2016 through March 2018. Four eligible patients were identified. The baseline characteristics of patients, amount of star fruit ingested, clinical manifestations, investigation results, and outcome were traced. Written, informed consent for this retrospective case series was obtained from all 4 patients during the follow-up reviews.

## Results

### CLINICAL CHARACTERISTICS

All 4 patients were male, aged 28, 50, 54, and 55 y. Patient 1 had uncomplicated diabetes mellitus without nephropathy. Patient 2 had been taking antiepileptic medications for a seizure disorder with poor drug compliance. Patients 3 and 4 did not have any known comorbidities. The number of ingested star fruits was different for each patient (Table 1). The most common symptoms of acute intoxication were nausea, vomiting, and abdominal and back pain, followed by a reduction in urine output and rising serum creatinine levels over hours to days. Urinalysis of all patients demonstrated oxalate crystals. Full blood count, liver function test, and inflammatory markers were all within normal limits. The patient who had a seizure disorder had undergone computed tomography and magnetic resonance imaging of the brain and electroencephalogram, all of which were normal.

### RENAL HISTOPATHOLOGY

The histopathologic examination of hematoxylin and eosin-stained renal tissues of all 4 patients revealed acute tubular damage with calcium oxalate crystals, interstitial edema, and inflammatory cellular infiltration (Figure 2). The presence of calcium oxalate crystals was confirmed with the brilliant birefringence seen under polarized light (Figure 3).

### TREATMENT AND OUTCOMES

The urine output and renal function of all 4 patients were monitored on a daily basis. Two patients needed intermittent hemodialysis for oliguria and uremia. In both patients, hemodialysis was continued for 1 wk. The other 2 patients did not require hemodialysis; their renal function improved with supportive treatment. The patient who had been taking antiepileptic drugs for a seizure disorder developed 2 generalized tonic clonic seizures. He was given intravenous diazepam initially. His routine oral antiepileptic medication was restarted. There were no further seizures reported after initiation of oral therapy with sodium valproate. On discharge, renal function was high in all 4 patients but recovered to normal within 1 mo after discharge.

## Discussion

There are 2 types of star fruit: sweet and sour types. The sour type contains far more oxalate than the sweet type.<sup>1-3</sup> Nephrotoxicity leading to AKI is a result of tubular obstruction by calcium oxalate crystals and

**Table 1.** Clinical summary of the 4 patients<sup>a</sup>

Reference	Age (y)	Comorbidities	No. of star fruits consumed	Known risk factor(s) for AKI	Need of RRT	Neurologic complication	Final outcome
1	55	Uncomplicated diabetes mellitus	4	Empty stomach	No	None	Recoverd to normal
2	54	None	Juice (from 6 star fruits)	None	No	None	Recoverd to normal
3	28	Epilepsy, poor drug complince	6	Empty stomach	HD done	2 fits	Recoverd to normal
4	50	None	3	Dehydration	HD done	None	Recoverd to normal

AKI, acute kidney injury; RRT, renal replacement therapy; HD, haemodialysis.

<sup>a</sup>All were male patients.

apoptosis of the renal tubular epithelial cells.<sup>4,5,11</sup> Star fruit-induced nephrotoxicity of varying severities has been reported from different regions of the globe, including Asia and Latin America.<sup>9-14</sup>

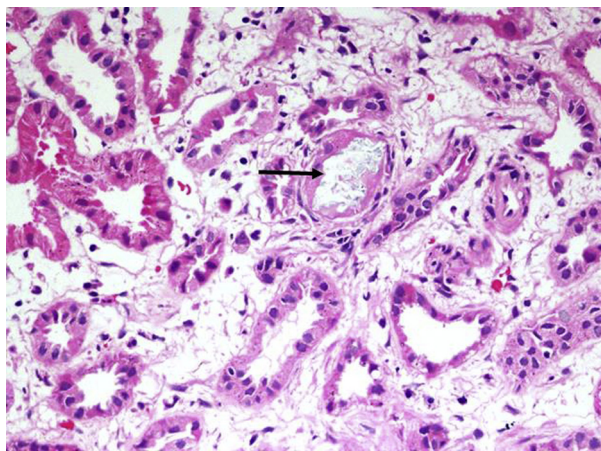
Chronic kidney disease has been identified as the main risk factor for star fruit-induced renal toxicity. Star fruit juice volume of around 25 mL is known to cause nephrotoxicity<sup>12,13</sup> in patients with chronic kidney disease. Other known risk factors are dehydration, the volume of ingested star fruit, and ingestion on an empty stomach.<sup>12,14</sup> The current case series confirms these risk factors given in the literature. An additional finding is that the type of star fruit could be a risk factor, as all 4 patients consumed sour star fruits. This could be due to the higher oxalate concentration in the sour type.<sup>1,2</sup>

Symptoms are known to occur within hours of ingestion, with the best described being hiccups, nausea, vomiting, and neuropsychiatric manifestations such as insomnia and/or seizures. We observed back pain that radiates from loin to groin in all 4 patients, apart from

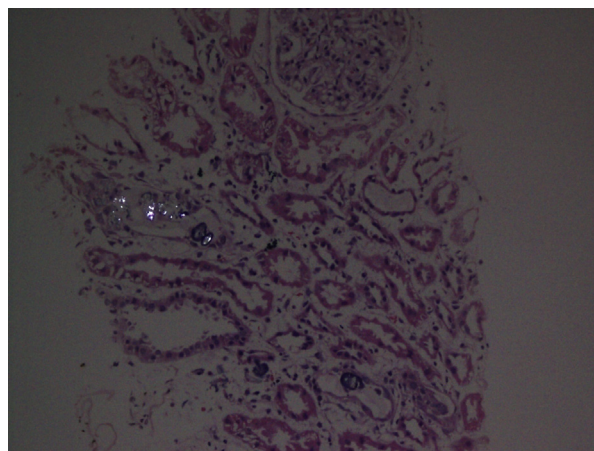
symptoms described previously. This could be due to the movement of oxalic acid crystals down the ureters. Urine analysis was a useful investigation that revealed oxalate crystals in all patients.

Patients with severe AKI need hemodialysis or hemofiltration.<sup>15,16</sup> Peritoneal dialysis is ineffective, especially in the presence of neurologic manifestations.<sup>15,16</sup> Two of our patients required hemodialysis for 1 wk. Renal function and urinalysis results of all 4 patients became normal within 1 mo after star fruit ingestion.

The patient who had a history of seizure disorder experienced 2 generalized tonic clonic convulsions. His neurologic examination was normal, with normal computed tomography, magnetic resonance imaging brain, and electroencephalogram findings. This could simply be neurotoxicity of star fruit. Establishing the cause of convulsions was difficult because his poor adherence to medication and renal failure could have reduced the seizure threshold.



**Figure 2.** Hematoxylin and eosin staining x400; a tubule plugged with translucent calcium oxalate (arrow).



**Figure 3.** Hematoxylin and eosin staining x200 viewed with polarized light, causing calcium oxalate crystals to polarize.

These 4 patients are unusual in that they developed AKI with underlying normal renal function. Only 2 other similar cases have been reported in the literature.<sup>14,17</sup> We believe AKI due to star fruit ingestion to be much more frequent than indicated in the literature. Clinical workup for unexplained AKI in Sri Lanka should include evaluation of recent ingestion of star fruit.

## Conclusions

This study highlights that AKI is a rare and serious complication after ingestion of star fruit. The type and volume ingested and some patient factors may play a role in the pathogenesis of AKI. The outcome for patients may be excellent with appropriate treatments. Public education and improving awareness among healthcare workers are important for early detection and proper management of this serious uncommon complication.

Author Contributions: Study concept and design (NH, KW); involvement of the patient management and data retrieval (NH, GK, TD); histopathological examination and interpretation (NR); literature search (NH, KW); drafting and writing the case series (NH, KW, GK, TD, NR); review and approval of the final manuscript (NH, KW, GK, TD, NR).

Financial/Material Support: None.

Disclosures: None.

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