

Continuous Renal Replacement Therapy Clearance Rate for Salicylate Toxicity in Multi-System Trauma*

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ABSTRACT

The management of patients with concomitant xenobiotic toxicity and multisystem trauma can be complex. While hemodialysis is generally the modality of choice for extracorporeal elimination of salicylates, the potential for large volume shifts and hypotension may pose a risk in patients with traumatic brain injury. An alternative therapy to hemodialysis is continuous renal replacement therapy, which has slower clearance rates than hemodialysis, but has decreased adverse effects in cases of traumatic brain injury. However, there are few published reports of clearance rates of salicylates using continuous renal replacement therapy. We report a case of multisystem trauma with concomitant intentional salicylate overdose in which continuous renal replacement therapy was employed. The salicylate clearance rate that was obtained in this case was 7.5 mL/minute using continuous veno-venous hemodiafiltration, a form of continuous renal replacement therapy.

Keywords: CRRT; Clearance Rate; Salicylate Toxicity; Multisystem Trauma

1. Introduction

Continuous renal replacement therapy (CRRT) was first introduced over 20 years ago as an alternative to hemodialysis (HD) for management of unstable and critically ill patients [1]. Joy *et al.* have characterized all forms of CRRT in a primer that describes the physics, methodology, and employment [2]. Continuous veno-venous hemodiafiltration (CVVHD, a form of CRRT) has since been described for use in management of toxicity in hemodynamically unstable patients who cannot tolerate dialysis, although this point remains controversial [3,4]. A major advantage of CVVHD is ease of administration, as this can be done by ICU staff rather than necessitating transport to a dialysis unit. Additionally, CRRT can be run 24 hours per day [3]. While most reports describe the use of CRRT in patients with acute kidney injury (AKI), there are few reports suggesting their utility in cases of salicylate toxicity.

2. Case Report

In a self-harm attempt, an 18 year-old female overdosed on an unknown quantity of salicylate prior to jumping in front of traffic and being struck by a vehicle at high velocity. She was reported to have a GCS of 3 on the scene,

and was immediately intubated by paramedics and transferred to a level 1 trauma center.

Her trauma evaluation revealed multiple injuries including a subdural hematoma, renal laceration, multiple rib fractures, pulmonary contusions, and several long bone fractures. Initially, medication overdose was neither suspected nor screened for. She was admitted to the trauma ICU and soon after became hyperthermic (38.9 C) and hypotensive (85/41).

Three hours into her trauma ICU course, after investigation by the trauma department's social worker, screening for common xenobiotics of abuse was undertaken. A serum salicylate concentration of 24.7 mg/dL (therapeutic range 10 - 25 mg/dL) was noted (the remaining toxicology screening was negative, although she may have co-ingested aripiprazole as well). An arterial blood gas at the same time noted: pH 7.08, pCO₂ 71 mmHg, pO₂ 42.1 mmHg and HCO₃ 19 mmol/L while ventilated on 100% FiO₂. Her serum creatinine was 1.52 mg/dL. A sodium bicarbonate drip was initiated (3 amps of D50 added to 1L of D5 Normal Saline at 150 mL/hr) and she received 2 doses of activated charcoal (50 g) via nasogastric tube. Despite normalization of serum bicarbonate levels and aggressive ventilator management, the patient had refractory respiratory acidosis. Over the next 8 hours, the salicylate concentrations rose to 45.2 mg/dL. (Course of vitals and labs are summarized in **Table 1**). We felt

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Table 1. Clinical course of vitals and labs.

	Tmax	BP	pH	pCO ₂	pO ₂	HCO ₃ ⁻	Cr	Salicylate level
0 hours	38.9°C	85/41						
3 hours			7.08	71 mmHg	42.1 mmHg	19 mmol/L	1.52 mg/dL	24.7 mg/dL
11 hours								45.2 mg/dL

Tmax = maximum temperature; BP = blood pressure; pCO₂ = partial pressure of CO₂; pO₂ = partial pressure of O₂; HCO₃⁻ = bicarbonate; Cr = creatinine.

this reflected both continuous absorption (despite two doses of activated charcoal) and decreased renal elimination (likely from persistent acidemia and aciduria). While a salicylate concentration of 45.2 mg/dL would not prompt dialysis in most cases, the upward trend and inability to control serum pH was concerning. Nephrology was consulted with a request to initiate dialysis.

The decision to use continuous veno-venous hemodiafiltration (CVVHDF), a form of continuous renal replacement therapy (CRRT), rather than HD was considered due to the patient's head injury, hypotension and the relatively low concentrations of serum salicylate. Owing to slow clearance, CRRT in general has a limited role in most acute overdose scenarios. In this case, the multi-specialty team felt the risk of worsening traumatic brain injury was greater than the risk of slower salicylate clearance. A blood flow rate of 150 mL/min was chosen, yielding a salicylate clearance rate of 7.5 mL/min with an extraction ratio of 5. At this rate, it took approximately 48 hours to completely clear salicylate.

3. Discussion

Broadly speaking, CRRT currently has a limited role in toxicology due to the slower xenobiotic clearance. There is a paucity of data reporting clearance rates with CRRT compared to conventional HD for most toxins, including salicylates. While there is evidence that CRRT is better tolerated than HD in the hemodynamically unstable patient, whether there is an impact on patient outcome is debated [2,5]. Wrathall, *et al.* reports 3 cases suggesting benefits of using CRRT for salicylate toxicity particularly in cases of severe salicylate toxicity with no available HD or in the hemodynamically unstable [6]. Our case further supports the use of CRRT, particularly in the hemodynamically unstable trauma patient with salicylate

overdose of unknown quantity. We posit that in situations where HD may have an unfavorable risk profile, and time allows, CRRT may be considered as an alternative modality of enhanced elimination. We report successful clearance of salicylates with a clearance rate of 7.5 mL/min and an extraction ratio of 5 when continuous veno-venous hemodiafiltration is utilized.

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