CASE REPORT

Salmonella myocarditis in a young adult patient presenting with acute pulmonary edema, rhabdomyolysis, and multi-organ failure

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Summary
The mortality and morbidity of salmonella infections is seriously underestimated. Salmonella myocarditis is an unusual complication of salmonella sepsis in adults. Cases that do occur may be associated with high morbidity and mortality. We present a rare case of salmonella myocarditis with multi-organ failure in a previously healthy young adult man who was brought to the emergency room with fever, diarrhea, shortness of breath, and altered sensorium, discovered to have acute pulmonary edema and respiratory compromise for which he was assisted with mechanical ventilation for 8 days. Blood culture grew Salmonella typhi. Biochemically he exhibited myocardial, hepatic, and muscular enzymatic surge with renal failure, features of rhabdomyolysis, and disseminated intravascular coagulation. The patient showed a progressive improvement on treatment with ceftriaxone for 2 weeks in addition to decongestive therapy. He was discharged in good condition afterward.

Introduction

Typhoid fever is both a water- and food-borne gastrointestinal infection, common among children and young adults in developing countries, with an estimated global prevalence between 16 million and 33 million cases per year, with 700,000 deaths [1,2].

Typhoid fever is a life-threatening illness rarely complicated by myocarditis. Inflammatory myocarditis caused by non-viral infective agents is nowadays rare. It usually occurs in immuno-suppressed patients with secondary involvement of the myocardium [3]. Salmonella myocarditis may produce variable clinical manifestations from latent to severe clinical forms, such as acute congestive heart failure and sudden cardiac death.

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Postmortem studies suggest that myocarditis is a major cause of sudden unexpected death in young adults and may account for 20% of cases [6]. Rhabdomyolysis associated with Salmonella typhi infection has only been reported in a few cases [7,8]. However, there have been more reported cases associated with S. enteritidis [9,10]. We present the case report of a young adult man brought with fever, diarrhea, shortness of breath, and altered sensorium due to S. typhi infection culminating in myocarditis, rhabdomyolysis, and multi-organ failure.

Case report

A 34-year-old Indian man was brought to the emergency room by emergency medical services after becoming unconscious on a nearby avenue. Not much history data were available upon presentation, although on retrospect he had 3 days’ history of fever and frequent diarrhea, his symptoms had intensified before admission, and he became confused and lethargic.

The patient had no previous health problems or coronary artery disease risk factors, he was not on any medications and had no allergies. There was no history of alcohol, tobacco, or illicit drug use. He had no witnessed convulsions or recent contact with animals or anyone with a febrile illness.

Physical examination on arrival revealed a well developed but ill-looking young man, dehydrated, orthopneic with blood pressure 98/55 mmHg, heart rate 142 beats/min, respiratory rate 28 min⁻¹, temperature 39.1 °C, and O₂ saturation 98% on room air. He was somnolent and he had no meningismus or focal neurological signs. The cardio-respiratory examination revealed bilateral fine basal crepitations with no murmurs or pericardial rub. Abdominal and musculoskeletal examinations were normal with no skin rash. While he was in the emergency room, he developed increasing breathlessness and crepitation to mid chest with respiratory compromise (O₂ saturation 71%), and signs of circulatory hypoperfusion. An assisted mechanical ventilation was established and he was then admitted to medical intensive care unit (MICU) where a central venous line was inserted.

The laboratory investigations upon arrival showed creatine kinase (CK) and creatinine kinase isoenzyme MB (CK-MB) were elevated to 6341 U/l and 409.5 ng/ml, respectively, troponin T was 0.26 ng/ml (normal: <0.1), troponin I was 7.86 ng/ml (normal: <0.08), and myoglobin was 32,480 ng/ml. Leukocyte count was 4.5 × 10³ μl⁻¹ (neutrophils 87.7%, lymphocytes 11%, monocytes 1.2%), hemoglobin 12 g/dl, platelet count 47 × 10⁹ l⁻¹. In regard to his hepatic function, the serum bilirubin was normal, but liver enzymes were elevated, aspartate aminotransferase 2320 U/l and alanine aminotransferase 559 U/l, however alkaline phosphatase was normal. Total protein was 62 g/l and serum albumin 31 g/l. His renal function showed urea nitrogen 17.9 mmol/l, serum creatinine 210 μmol/l and corrected calcium 1.77 mmol/l whereas serum sodium, potassium, magnesium, and phosphorous were normal. The coagulation studies revealed an international normalized ratio of 1.8 and a partial thromboplastin time of 41.4 s. D-Dimer test was elevated 9087 μg/l (normal: up to 280 μg/l). Arterial blood gas analysis showed metabolic acidosis with pH 7.188, pCO₂ 40.1 mmHg, pO₂ 74.2 mmHg, and HCO₃ 14.7 mmol/l. Toxicology screening for drugs and alcohol was negative.

Liver, spleen, and kidneys were with normal sizes on bedside abdominal ultrasound but mild ascites

Figure 1  The electrocardiogram (ECG) showed sinus tachycardia, heart rate 146 min⁻¹, and nonspecific ST, T changes.
Salmonella myocarditis in a young adult patient

Figure 2  (A) Admission chest X-ray consistent with acute pulmonary edema. (B) Chest X-ray showing improvement after intensive therapy.

detected. Computed tomography scan of the head and cervical spine was normal. Cerebrospinal fluid was clear with normal cytology, protein, and sugar content, culture revealed no growth and Gram and acid fast bacilli stains were negative. Endotracheal tube secretion showed no bacterial growth. Two bottles of blood culture grew *S. typhi*. Urinalysis showed significant myoglobin, 3+ blood and 2+ protein but no active sediment or bacterial growth. Serology for both hepatitis B and C viruses were negative.

The electrocardiogram (ECG) showed sinus tachycardia, heart rate 148 min⁻¹, and nonspecific ST, T changes (Fig. 1). Chest X-ray showed bilateral perihilar vascular congestion suggestive of pulmonary edema with no gross cardiomegaly (CT ratio: 0.5) (Fig. 2A). Transthoracic echocardiography showed severe left ventricular systolic dysfunction with ejection fraction (LVEF) of 23% and akinesia of both mid inferior and anterior segments with hypokinesis of the rest of myocardium. No vegetations were seen (Fig. 3).

The initial diagnosis of complicated heat stroke was raised until the result of blood culture emerged after 2 days. Meanwhile he was managed with intravenous fluid resuscitation, antibiotics together with diuretics and sodium bicarbonate to maintain an
alkaline urine. The final diagnosis of *S. typhi* infection and related myocarditis, rhabdomyolysis, and multi-organ failure was made based on the clinical, echocardiographical findings and laboratory results. The patient was extubated after 8 days of assisted ventilation while he showed a progressive clinical and biochemical improvement on treatment with ceftriaxone for 2 weeks (Fig. 2B). His hematological and biochemical parameters were normalized, and a follow up echocardiography performed before discharge showed mild improvement with LVEF of 30% and he was discharged afebrile in good condition and planned for follow up. Another echocardiography performed about 5 months after initial presentation revealed more improvement in LV function with EF 42% and mild global hypokinesia (Fig. 4).

**Discussion**

The incidence of myocarditis is unknown and remains underestimated in spite of the development of various diagnostic modalities. In the case presented, the diagnosis of *S. typhi* infection and related myocarditis was made based on the clinical, laboratory, and echocardiographical results. The rise in CK-MB and troponins is noted in myocardial damage of any cause[11]; however, Smith et al. found CK elevation in only 5.7% and troponin I elevation in 34% of patients with autoimmune myocarditis[12].

In one study of 100 patients with bacteriologically or serologically documented enteric fever, Mohanan et al. found seven cases with clinical evidence of myocarditis[13]. Rowland found myocardial involvement in 9 out of 539 patient (1.2%) in another study[14].

The common ECG abnormalities in salmonella myocarditis mentioned in other reports were not seen in our case[15—19]. Moreover the characteristic paradoxical bradycardia in the febrile patient was also not detected. The absence of left ventricular dilatation and mild improvement in ventricular function within a short period are characteristic of fulminant course of myocarditis, with low risk of progression to dilated cardiomyopathy, whereas acute myocarditis with less severe hemodynamic compromise more often leads to persistent cardiac dilatation[20].

The elevated serum concentrations of CPK and myoglobinuria causing renal dysfunction are characteristic features of the syndrome of rhabdomyolysis in this patient. Infections are a well known but less common cause of rhabdomyolysis, and should always be considered in the differential diagnosis. There have only been few reported cases of rhabdomyolysis related to *S. typhi* infection but more have been reported cases with other *Salmonellae* species [7—10]. Immunologically mediated myocardial damage or bacterial invasion of muscles and generation of toxins are the proposed pathophysiological mechanisms of rhabdomyolysis and myocarditis in salmonella infections. Balanced intravenous fluid therapy and sodium bicarbonate to maintain an alkaline urine to prevent the dissociation of myoglobin to its nephrotoxic metabolite ferrihemate can be of value in management of rhabdomyolysis-related nephrotoxicity [21,22].
The presentation with congestive heart failure and pulmonary edema in young patients, without a history of heart disease, especially when it is concurrent with infection, should arouse suspicion of myocarditis. The reversible nature of myocarditis in typhoid is recognized and early institution of diuretics and specific antibiotic therapy can help tide over the period until the inflammatory process subsides.

The definitive diagnosis of myocarditis may require an endomyocardial biopsy. However, in our case we thought this invasive test might not be indicated just to establish direct proof of inflammation when the disease can be clinically diagnosed based on positive blood culture of *S. typhi* along with the biochemical, echocardiographic examinations, and reversible nature of congestive cardiac failure. Moreover, the Dallas criteria used for the histological evaluation of biopsy specimens probably underestimate the true incidence of myocarditis [6].

**Conclusion**

Although rare, rhabdomyolysis and multi-organ failure are recognized complications of *S. typhi* infection in addition to myocarditis. This should be kept in mind when reviewing clinical and laboratory findings, as early recognition and management of these complications can improve survival.

**References**


