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## Case Report

# Neurological involvement and MRI brain findings in an adult with hemolytic uremic syndrome: A case report ☆,☆☆

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## ABSTRACT

Hemolytic uremic syndrome is a frequent complication of shiga toxin producing *Escherichia coli* in pediatric population. It rarely affects adults with extremely rare neurological manifestation. We present a case of hemolytic uremic syndrome in a 64-year-old male who presented with a bloody diarrhea 30 minutes after eating an expired meat sandwich. Shiga-toxin producing *Escherichia coli* O157:H7 was confirmed as the causative agent. The patient developed neurological manifestations with persistent encephalopathy that ultimately leads to his death after 22 days of hospitalization. Magnetic resonance imaging findings was significant for signal changes in the thalami, tectum, insulae, and central pons, impressive of hemolytic uremic syndrome.

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## Introduction

Hemolytic uremic syndrome is a multisystem disorder that has been typically described as a clinical triad of acute renal failure, hemolytic anemia, and thrombocytopenia. The pathophysiology of hemolytic uremic syndrome is complex with different pathophysiologic patterns [1], moreover, infectious processes is the most common associated etiological factor, particularly with Shiga toxin-producing *Escherichia coli*.

Shiga toxin-producing *Escherichia coli* is a subgroup of Enterohemorrhagic *Escherichia coli* in which the bacteria produce a potent toxin resembling that produced by *Shigella* [2]. Shiga toxin-producing *Escherichia coli*-hemolytic uremic syndrome is predominantly a disease of children with a proportion of 85%-90% of cases [2]. Though hemolytic uremic syndrome is rare in adults with extreme rare involvement of the central nervous system, an epidemic of hemolytic uremic syndrome which occurred in Hamburg, Germany in 2011, recorded predominant involvement of immunocompetent adults with

**Abbreviations:** ADC, Apparent diffusion coefficient; CNS, Central nervous system; CT, Computed tomography; DWI, Diffusion weighted imaging; EHEC, Enterohemorrhagic *Escherichia coli*; E. *Coli*, *Escherichia coli*; FLAIR, Fluid attenuated inversion recovery; GCS, Glasgow coma scale; HUS, Hemolytic Uremic Syndrome; IV, Intravenous; MRI, Magnetic resonance imaging; NICU, Neurological intensive care unit; STEC, Shiga toxin producing E. *Coli*.

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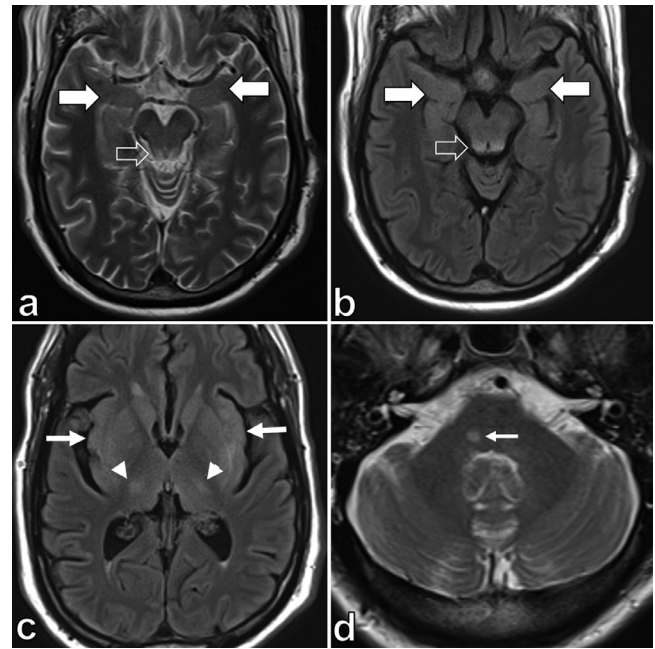
neurological complications [3]. The causative agent was identified, and it was an aggressive Enterohemorrhagic *Escherichia Coli* O104:H4. In this report, we present a case of neurological complication in an adult with Shiga toxin producing *Escherichia coli* - hemolytic uremic syndrome that ended tragically with the patient's death after persistent encephalopathy.

## Case report

A 64-year-old white man presented with a bloody diarrhea and diffuse abdominal pain 30 minutes after eating an expired hamburger sandwich. The patient had a history of alcohol use disorder, rheumatoid arthritis, hypertension, a cerebrovascular accident, and chronic renal failure. Stool analysis was done which was positive for Shiga toxin type 2. Computed tomography of the abdomen and pelvis with contrast was done that showed diffuse severe colitis with mild intraperitoneal free fluid. The presumed diagnosis based on computed tomography findings was pseudomembranous colitis vs ulcerative colitis. Then, the patient developed acute renal failure, thrombocytopenia, hemolytic anemia, and persistent leukocytosis. The most likely diagnosis at that time was Shiga toxin producing *Escherichia coli* gastroenteritis complicated by a hemolytic uremic syndrome. The patient started to have seizures with persistent encephalopathy afterwards. Computed tomography of the head without intravenous contrast showed prominent ventricles, basal CSF cisterns, and subarachnoid spaces that was consistent with mild diffuse cerebral atrophy. Magnetic resonance imaging (MRI) without intravenous contrast was done, which confirmed slight dilatation of the ventricles and cortical sulci without extra-axial fluid collection. Diffusion weighted imaging (DWI) excluded acute ischemia. The patient was admitted to the neurological intensive care unit where supportive care was continued. The patient mental status worsened, and he developed generalized seizures. The MRI of the brain was ordered again. At this time, MRI of the brain depicted multifocal patchy areas of T2 and fluid attenuated inversion recovery (FLAIR) hyper intense signal changes within the bilateral insular cortices and adjacent white matter "extreme and external capsules," bilateral lateral thalami, tectal plates with the periaqueductal grey matter, and central pons (Fig. 1). His mental status continued to worsen till he was intubated. Glasgow coma scale was down to 3 then he was died after 15 days of admission, and 22 days after onset of symptoms.

## Discussion

Hemolytic uremic syndrome is a form of thrombotic microangiopathy, which begins from an initial endothelial injury, mainly affects the kidneys [2]. Central nervous system involvement is the most common extrarenal complication that results in a wide variety of symptoms in pediatric population; irritability, lethargy, confusion, altered mental status, seizures, and stroke [4]. Other rare symptoms include hemiplegia, cortical blindness, dysphasia, diplopia, and facial nerve palsy [4].



**Fig. 1 – A 64-year-old male with hemolytic uremic syndrome. Axial T2 weighted MRI (a) and FLAIR (b) at the level of cerebral peduncles demonstrated symmetrical hyper intense signal within the mesial temporal lobe “wide solid arrows” as well as the tectal plate and periaqueductal grey matter “wide hollow arrows.” Axial FLAIR image (c) at the head of caudate level showed bilateral areas of hyper intense signal involving the insular cortices “white arrows” and adjacent extreme/external capsules. Focal foci of hyper intense signal also noted within the lateral thalami “arrow heads”. Axial T2 weighted MR image at middle cerebellar peduncles level (d) showed a punctate focus of hyper intense signal is noted within the right dorsal pons “white arrow.”**

Adult population has more or less the same neurological manifestations for example patients from Shiga toxin producing *Escherichia coli* O104 2011 Hamburg [3], Shiga toxin producing *E coli* O111 2008 Oklahoma [5], and 2011 Japan [6] epidemics suffered from hyperexcitability syndromes, increased muscle reflexes, seizures, neuropsychological abnormalities, impaired concentration, hemiparesis, stupor, and coma [3,5,6]. Death after persistent encephalopathy has been reported in the 3 outbreaks.

Regarding imaging, there are no unified model of identified pathognomonic pattern on brain MRI possibly due to different patient populations and not standardized MRI protocol [3]. There are distinguished similarities in imaging findings among the previous published cases and our case [1]. The hemolytic uremic syndrome is characterized by 2 phases: the acute phase and the subacute phase [2]. The most common observed findings in the acute phase include marked T2-FLAIR nonexpansile hyperintensities typically involving bilateral thalamus, particularly lateral portions, and bilateral dorsal pons [3]. The centrum semiovale, splenium of corpus callosum, basal ganglia - putamen and globus pallidus,

external capsule, dorsal brain stem and cerebellum could be involved [3,4]. Less common findings include involvement of the mesial temporal lobes -mimicking severe limbic encephalitis-, cortical grey matter, posterior limb of internal capsule, cerebellum, head of caudate nucleus, tegmentum, dentate nucleus, and periaqueductal grey matter [4]. These changes are usually transient and disappear with clinical improvement. DWI might demonstrate transient focal areas of restricted diffusivity, suggestive of cytotoxic edema [3].

In the subacute phase, the brain parenchymal changes subside or disappear; few cases may show persistent cerebral hyperintensities [3]. In addition, mild cerebral atrophy was described in some cases [4].

Our MRI imaging findings noted above have some similarities to findings described in Wernicke's encephalopathy. Both syndromes have bilateral and symmetrical T2 and FLAIR hyperintensities in multiple areas for example, the thalami, tectal plate, and periaqueductal area. Wernicke's encephalopathy typically affects mammillary bodies [7]. Wernicke's encephalopathy can present with restricted diffusion pattern on DWI and apparent diffusion coefficient (ADC). Interestingly, MRI findings have no significant correlation with the neurological manifestation [7]. Therefore, the impact of MRI findings on the clinical judgment is limited due to the absence of established radiologic criteria. Nevertheless, with a suspected case of hemolytic uremic syndrome with neurologic manifestations, symmetric transient vasogenic edema of the pons in adult patients is the most common finding and consequently it is a highly suggestive sign [3].

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## Conclusion

Hemolytic uremic syndrome is rarely affecting adult population and it rarely affects the central nervous system. The main MRI findings are T2 hyper intensities in bilateral thalamus and bilateral dorsal pons. DWI and ADC are mostly normal how-

ever it may present with restricted diffusivity in the acute phase representing a cytotoxic edema. Findings are mostly transient and disappear in the subacute phase. They also do not correlate with neurological manifestation.

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## Written informed consent

Informed consent to participate in this study and for publication was obtained from the patient's wife.

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## REFERENCES

- [1] Fakhouri F, Zuber J, Fremeaux-Bacchi V, Loirat C. Haemolytic uraemic syndrome. *Lancet* (London, England) 2017;390:681–96.
- [2] Cody EM, Dixon BP. Hemolytic uremic syndrome. *Pediatr Clin North Am* 2019;66:235–46.
- [3] Wengenroth M, Hoeltje J, Repenthin J, Meyer TN, Bonk F, Becker H, et al. Central nervous system involvement in adults with epidemic hemolytic uremic syndrome. *AJNR Am J Neuroradiol* 2013;34:1016–21 S1.
- [4] Khalid M, Andreoli S. Extrarenal manifestations of the hemolytic uremic syndrome associated with Shiga toxin-producing *Escherichia coli* (STEC HUS). *Pediatr Nephrol* 2018 Epub ahead of print. doi:10.1007/s00467-018-4105-1.
- [5] Piercefield EW, Bradley KK, Coffman RL, Mallonee SM. Hemolytic uremic syndrome after an *Escherichia coli* O111 outbreak hemolytic uremic syndrome and *E coli* O111 outbreak. *JAMA Intern Med* 2010;170:1656–63.
- [6] Takanashi J, Taneichi H, Misaki T, Yahata Y, Okumura A, Ishida Y, et al. Clinical and radiologic features of encephalopathy during 2011 *E coli* O111 outbreak in Japan. *Neurology* 2014;82:564–72.
- [7] Manzo G, De Gennaro A, Cozzolino A, Serino A, Fenza G, Manto A. MR imaging findings in alcoholic and nonalcoholic acute Wernicke's encephalopathy: a review. *Biomed Res Int* 2014;2014:503596.