Hepatomyoencephalopathy in Malkangiri district of Odisha, India

During September through November 2016, some 100 children died due to acute brain disease in Malkangiri district, southern Odisha, India. Most deaths were at first attributed to Japanese encephalitis (JE) due to the following reasons: JE had been reported in Malkangiri district in previous years and diagnostic test for JE was positive in a few children in 2016; JE season is September through November; the vector mosquitoes and amplifying hosts, namely pigs, are prevalent in Malkangiri district. However, a number of cases turned out negative for JE test. Therefore, in the last week of October, the Department of Health, Government of Odisha, constituted a team to investigate the cases of non-JE acute brain disease with high mortality[1].

We conducted a rapid review and investigations during the first two weeks of November. Two of us (G.A. and M.M.P.) had visited Malkangiri district during October when the clinical pattern of non-JE cases was found to be stereotyped: relatively abrupt onset and rapid deterioration during several hours with unconsciousness, muscle rigidity and generalized seizures. Cerebrospinal fluid (CSF) samples showed no increase in cell count. Death occurred within 2–4 days of onset of illness, and those who survived recovered completely with no neurological deficit. These clinical features are typical of acute encephalopathy and quite different from those of acute encephalitis[2]. One of us (G.A.) collected blood serum, CSF and urine samples from these non-JE cases and stored them frozen. They were useful for further investigations.

Spatial and temporal clustering of acute encephalopathy had been reported in recent years in several districts of western Uttar Pradesh (UP) and in Muzaffarpur district, Bihar[3–9]. In UP, the disease was hepatomyoencephalopathy

Table 1. Levels of serum enzymes in hepatomyoencephalopathy cases of Malkangiri district, Odisha (n = 15)

Parameters	Range of enzyme levels (IU/l)	Normal range of enzyme levels (IU/l)
AST	1068–15297 (4076)	10–40
ALT	1260–6957 (2806)	10–40
CPK-MB	706–10476 (2703)	0–24
LDH	1500–32472 (6447)	225–460

Values in parenthesis indicate mean of enzyme levels of 15 cases.
AST, Aspartate transaminase; ALT, Alanine transaminase; CPK, Creatine phosphokinase; LDH, lactate dehydrogenase.

Figure 1. *Cassia occidentalis* plant in Malkangiri district, Odisha having pods containing seeds.

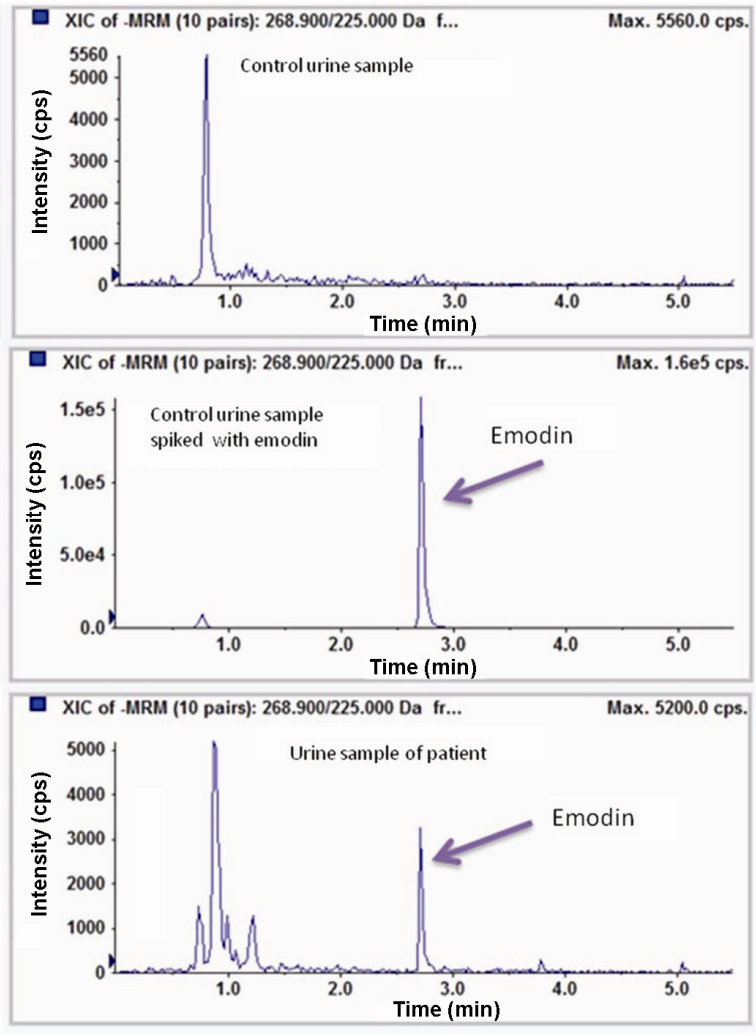

Figure 2. LC-MS of urine sample of a hepatomyoencephalopathy patient from Malkangiri district, Odisha.

(HME), affecting the liver, skeletal and heart muscles and the brain, indicated by very high levels of liver and muscle enzymes in the blood, and caused by children eating the raw unripe beans of an annual weed plant, *Cassia occidentalis*[3–5]. The toxin was identified and characterized as anthraquinones, which could be detected in urine samples of sick children[6].

In Bihar, the disease was acute hypoglycaemic encephalopathy triggered in malnourished children who missed their evening meals, by an inhibitor of mitochondrial fatty acid oxidation cycle of neoglucogenesis. The inhibitor was found to be methylene cyclopropyl glycine, present in the edible portion of litchi fruits[7–10]. Cases occurred only during litchi harvesting season[7,8].

Malkangiri district has no litchi cultivation and so litchi-associated hypoglycaemic encephalopathy was ruled out. On the other hand, *Cassia occidentalis* grows luxuriantly, and we found that children have easy access to the plants and the pods with beans (Figure 1). Suspecting hepatomyoencephalopathy as the non-JE disease, we investigated blood sera of 15 children; all showed markedly elevated levels of liver and muscle enzymes (Table 1). In 8 of the 15 cases, blood sugar was tested and the results showed hypoglycaemia, ranging from 11 to 61 mg/dl. Hypoglycaemia was a feature in hepatomyoencephalopathy cases in western UP[3–5].

Since history of children eating the fresh raw beans prior to illness could not be ascertained with certainty, we resorted to testing urine samples of four children with hepatomyoencephalopathy for the presence of anthraquinone derivative(s), and all samples gave positive results. Figure 2 displays the liquid chromatography–mass spectra (LC–MS) of representative sample of urine showing the presence emodin, an anthraquinone. Detailed analysis of anthraquinone derivatives in blood sera and urine samples of additional children with hepatomyoencephalopathy is under progress.

In summary, we report the occurrence of hepatomyoencephalopathy in Malkangiri district, a second geographic location other than western UP. Prevention is fairly easy, by way of public education to stop children form eating fresh raw beans of the plant. In western UP the disease has virtually disappeared as a result of proper health education[11]. We hope similar efforts are undertaken in Malkangiri district for eradication of the disease.

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Solar-powered on-farm storage structure for fruits and vegetables

Preserving fruits and vegetables in cold storage has been a critical area of concern because at low temperature, these perishable commodities can be preserved in their wholesome state for longer periods. However, the absence of cold storage facilities to accommodate the ever-increasing supply of fruits and vegetables has compelled the producers to adopt alternative storage practices; practices that in effect would preferably be economical than renting space in cold store and more efficient than rustic storage producers[1].

Fruits and vegetables are highly perishable, and if not properly handled at their optimum condition after harvesting or during packaging or transportation; they easily deteriorate and become unsuitable for consumption[2]. The world over postharvest losses are estimated at an average of 30–40% in fruits and vegetables before they reach the final consumer[3]. The postharvest losses of fruits and vegetables in India are about 30–35% (ref. 4).

Temperature and relative humidity are the two most important environmental factors influencing the quality and storage life of fresh produce[5,6]. If the surrounding air temperature is decreased to create storage at optimum levels within 4 h, the following are achieved: decrease in produce respiration rate; reduction of water loss from produce; concealment of ethylene production and significant